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A TEXT-BOOK

OF

GENERAL THERAPEUTICS

A TEXT-BOOK

OF

GENERAL THERAPEUTICS

LANE LIBRARY

BY

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Dedicated

TO

MY FRIENDS

THE PAST AND PRESENT STUDENTS OF GUY'S HOSPITAL

PREFACE.

THE lectures on therapeutics which I deliver at Guy's Hospital in the summer session are in part devoted to an account of modes of treatment which do not fall under the heading of drugs. I was asked to publish these lectures. It seemed to me that any value they might have would be increased if they were thrown into the form of a short text-book which included a description of all those medical therapeutical methods which are omitted in most books on therapeutics. To prepare this a very great many books, pamphlets and articles have been read, among them there is so much that is worthless that I am afraid I have not always been successful in separating the wheat from the chaff. The bibliography appended to each subject does not pretend to be complete; I have only named a few books which those of my readers who require further information may consult with advantage.

I am much indebted to several of my friends for their kind help and criticism. Dr. Ryle read through nearly all the manuscript. Dr. Pitt thoroughly revised and amplified the chapters on electricity, and Dr. A. T. Myers supplied me with much material for the chapters on hypnotism. I have to thank those authors who have allowed me to copy their woodcuts. The figures showing Ziemssen's motor points are taken from the seventh edition of Wood's *Therapeutics : its Principles and Practice ;* and that showing the operation of lavage is reproduced from the English edition of Strümpell's *Text-Book of Medicine*, by the kind permission of Mr. H. K. Lewis, the publisher.

65 Harley Street, W.
June, 1889.

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A TEXT-BOOK

OF

GENERAL THERAPEUTICS.

CHAPTER I.

GENERAL MEDICAL CLIMATOLOGY.

THE climate to which a patient should be sent has, in all times, been considered an important question, and those who lacked health have, if they could afford to do so, travelled far and wide in search of it. But in spite of the prominent position medical climatology has always held in medicine, we are still very ignorant about it, partly because the factors that make up a climate are very numerous, and often inscrutable, and partly because a change of climate usually means several coincident alterations in the mode of life, such for example as rest from business, regular meals, more exercise, and longer periods of sleep.

The only method of inquiry which can lead to any accurate results is first of all to investigate the influence upon the healthy body of each of those factors which collectively form a climate, and then as far as possible to apply the knowledge so obtained to those diseases which experience has shown to be benefited by a change of climate. The object of this chapter is to state what is known with any degree of certainty about the first part of the problem, and also briefly to indicate the causes which determine climate.

In selecting a climate for an invalid we must consider the following points :—

1.—The Purity of the Atmosphere.

The importance of this is self-evident. A London winter illustrates forcibly the pernicious effects of an impure atmosphere ; for example, not long ago a very thick fog during the cattle show in London, in December, killed several of the animals. In a hospital many patients are made worse by a fog, and it lengthens the column of deaths in the newspapers Generally speaking it carries off principally those who are old, or who suffer from bronchitis. The Black Hole of Calcutta is an instance of the fatal influence of atmospheric impurities ; and the improvement in health of the inmates, which has so often followed, when any large buildings such as barracks have been better ventilated is also proof to the same effect. Of those impurities which are dangerous to health the most important are very concentrated, for minute quantities of them make an atmosphere poisonous ; they are often products of respiration, and hence the evil effects of crowded rooms. Carbonic acid gas, which is much less baneful, should not exist in a greater quantity than six parts in a 1000.

In choosing a place for residence malarial exhalations must always be taken into account. As a rule the air is purer and therefore healthier in the country than in large towns. Atmospheric impurities aid the production of many disorders, such as phthisis, but apart from any definite disease those persons who habitually inhabit stale air are pale, weak, sickly, and ill fitted to withstand attacks of illness.

2.—The Temperature.

There are many circumstances which affect the temperature of a place, and of these the most powerful is its latitude, but nevertheless isothermal lines are by no means parallel to the equator, the reason being that local conditions operate largely.

Perhaps the most noteworthy of these is the presence of large masses of warm or cold water. The Gulf Stream is an example of this, for it makes the British Isles considerably warmer than places of the same latitude elsewhere. The reason why the influence of water is so great is that its specific heat is five times that of land, and therefore it parts with heat very slowly, but on the other hand, it requires much heat to raise its temperature slightly; a large mass of water consesequently cools the surrounding neighbourhood in summer and warms it in winter. A signal instance may be seen in the isothermic lines near Lake Baikal, in Siberia, which is over 2000 fathoms deep. In winter they bend well to the north of it, whilst in summer they turn to the south; in other words it warms the surrounding country in winter and cools it in summer. For the same reason equatorial oceans lower and polar oceans raise the mean temperature, the reverse being true of land.

The temperature of the prevailing wind has a great influence upon that of any place, as we constantly find in England, for the average temperature of a given month is lowered many degrees if during it north-easterly currents predominate. Hills which shut off winds also contribute to the determination of the temperature of the adjacent country, and the warmth of many of our south coast watering places is due to hills on the north and east.

Elevation above the sea-level diminishes the temperature about 1° F., for every 300–350 feet, the diminution being the greater the dryer the air, for a fall of temperature condenses the atmospheric moisture, and the latent heat thus set free keeps the temperature higher than it otherwise would be. In the evening it is often a little lower in the valleys than it is 400-500 feet up the mountain side: perhaps because more moisture being condensed higher up, more latent heat is set free, or because the cool air falls into the valley and the warm air ascends from it.

The condition of the atmosphere affects the temperature. Thus if the air be cloudy and full of moisture, much of the sun's heat is absorbed in its passage through it, and therefore the places over which clouds hang are cool. At night a moist cloudy atmosphere diminishes the terrestrial radiation, and consequently the earth is warmer than it would be on a clear night.

Both the range and the average of the temperature of a place must be considered before recommending it to an invalid. A climate of which the average is everything that can be desired is most unsuitable for prolonged residence, if the difference between the winter and summer temperatures be very great. A useful chart showing the annual range will be found in Scott's *Elementary Meteorology* (p. 38). Dr. Supan gives the following rules concerning it. (1) The range increases from the equator towards the pole, and from the coast towards the interior of a continent. (2) The regions of extreme range in the northern hemisphere coincide approximately with the districts of lowest temperature in winter. (3) The range is greater in the northern than in the southern hemisphere. (4) In the middle, and higher latitudes the west coasts have for the most part a less range than the east. (5) In the mountainous districts of the interior of continents the range diminishes with the height above the sea.

It will be noticed that nearly all these rules depend upon the modifying influence of the sea.

Usually we ought to know the monthly as well as the annual range and average, for most health resorts have their season during only a part of the year. The monthly isothermals often differ widely from the annual. Further information on this point will be given in Chap. II.

It is beyond our province to discuss the effects of great extremes of temperature upon the human body, because they are not to be recommended for any disease. It is difficult to be sure how far the mere heat of the tropics is harmful to Englishmen, as they may be affected by other circumstances, such as malaria and different modes of living.

A moderately cold temperature in a healthy man acts as a stimulus, and all the functions of the body are made more active. Circulation and respiration are increased in rapidity, and there is greater mental activity. The loss of heat is augmented, and consequently the production is greater. The cutaneous vessels contract, additional work is therefore thrown upon the kidneys, and a larger quantity of urine is secreted. The skin is pale, and the internal organs contain more blood. The appetite is increased, and less fluid is drunk because the perspiration is diminished.

A moderately high temperature produces the reverse effects.

There are many people who cannot be called seriously unhealthy, who nevertheless feel much better in cold weather, and who always complain of the enervating influence of warm weather. With most weakly persons the contrary appears to be true, but there are some exceptions, for I have noticed that chronic nervous organic diseases are decidedly improved by the stimulating effects of cold dry weather. Dr. Ryle tells me this is his opinion also, and he has seen it well exemplified in cases of paralysis agitans. The majority of feeble persons are unable to withstand even slight cold, they become torpid, lose their appetite, and if they be dyspeptic, suffer more than ever. They are also very liable to chilblains. Dr. Hermann Weber says that chlorosis, amenorrhœa and even hæmaturia are produced by exposure to cold especially if prolonged, but such results must be rare.

The very old, the very young, those who suffer much from cold, and those who cannot take exercise, are particularly unsuited for cold climates. If the respiratory mucous membrane be at all inflamed it is further irritated by a cool atmosphere, but soothed by a warm one.

3.—The Atmospheric Humidity.

The amount of moisture in the air is determined by several causes.

One of these is elevation, for the higher the altitude the less the atmospheric moisture. This diminution does not proceed regularly. It has been calculated that half the vapour in the atmosphere is in the lowest 6,000 feet.

Another is temperature; the higher this is, the greater the absolute quantity of moisture, but the amount is less, compared with the quantity which it is possible for the air at the higher temperature to contain, because the increased evaporation cannot take place with sufficient rapidity to counterbalance the rise of temperature; or, in other words, what is technically called the humidity, is less at a higher temperature than at a lower. This is the reason why the air is usually driest at mid-day.

One of the principal causes of moisture is the humidity of the prevailing wind. We have an excellent example of this in the south-west of England.

The quantity of moisture in the atmosphere greatly affects temperature, for when the air is very dry the radiant heat of the sun is very great. The air is driest at high altitudes and in cold weather, hence the great radiant heat at places such as Davos. In Arctic regions the pitch will bubble on the side of the ship exposed to the sun, at the same time as water freezes on the side in the shade.

When the amount of watery vapour contained in the air at a certain temperature is the most it can contain at that temperature it is said to be saturated. If the temperature of this air is lowered by any cause, some of the vapour is condensed, and cloud, fog, or mist results. These acquire additional importance as they keep off sunlight and heat; hence it is necessary to know how cloudy a health resort is, and at what time of year there is least cloud.

Local conditions operate so largely in determining the quantity of rain that it is impossible to predict from general considerations what it will be.

The chief of these conditions are:—First. The presence of mountains. These collect the watery vapour or rain on the side exposed to the moist wind, and force it up into the colder regions, where the vapour is condensed and falls as rain; for example, the greatest rainfall in England is in the Lake district, where warm, moisture-laden winds from the Gulf Stream are forced up the Cumberland mountains. Abercrombie states that in England at least, if the hills be less than 1,500 feet high, the vapour is liable to blow over them, so that rain may fall on either side or both sides. If the mountains be higher the rain falls only on the side exposed to the wind. Second. Cold winds on meeting warm air, condense the moisture in it. This is a frequent cause of rainfall in many places, such as the Gulf of Genoa. Third. The contact of moist, warm air, with the cold surface of the ground, condenses the moisture in the air, and rain ensues. This is the explanation of much of the rain which falls on our west coasts.

These general principles teach us why some places are much more rainy than others; but the knowledge of the annual rainfall is of little use unless we know the number of rainy days, and the time of year at which rain is most frequent. In Chapter II. this information will be found, and the accompanying figure (p. 9) shows the probability of rain in different parts of Europe for each month in the year, and from it we may learn the time of the rainy seasons in certain districts.

It is a familiar experience that rain warms the atmosphere the reason being that latent heat is set free by the condensation of the watery vapour.

Snow lying on the ground is rather beneficial than harmful to the invalid, for as it prevents the absorption of heat by the earth during the day there is less radiation at night, and consequently there are fewer winds and currents. Vapours, dust, and exhalations of all sorts are prevented from leaving the ground, which the snow also protects from severe frosts. Melting snow is however very bad for invalids, for the transition of water from the solid to the liquid form necessitates the absorption of a large amount of heat, whereby the air is made cold, and the presence of so much water makes it damp.

The temperature of a dry and moist atmosphere being the same, more moisture will be secreted from the skin and respiratory passages in the dry atmosphere than in the moist, because evaporation of the secretion being faster in the former it is more quickly renewed. As a consequence more heat is lost, and the patient feels cooler in the dry atmosphere. But owing to the diaphoresis less work is thrown upon the kidneys, and therefore if the air be hot and dry very little urine is secreted, but that little is high-coloured and concentrated. Dry air is bracing, but irritating to the respiratory mucous membrane, especially if it be at all inflamed; moist air on the contrary is enervating, and also soothes the mucous membrane of the air passages. Moisture combined with warmth favours the development of micro-organisms. If the air is laden with watery vapour and cold we feel much cooler than if the air were drier, and at the same temperature, because moist air conducts heat away from the body better than dry. This is one reason why we are often colder during a thaw than during a frost.

4.—Sunlight.

Sunlight produces no injurious consequences upon man so far as we know, excepting certain diseases of the skin. The mildest is a transitory erythema, and if this be severe it is accompanied by some swelling, much smarting, and after a time by desquamation. If the inflammation set up go a degree

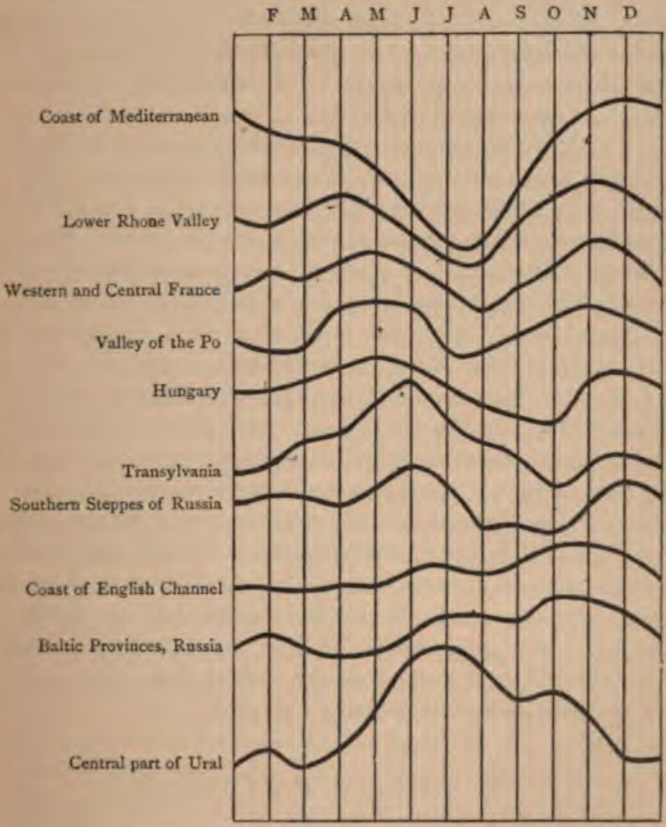

FIG. 1.—Monthly Rain probability for Europe (Köppen)

urther vesicles are formed, and we get the condition known as Eczema solare, which differs from true eczema, in that it appears not upon the thinnest parts of the skin, but upon those most exposed to the sun. If the exposure be long continued the skin becomes either freckled or tanned. Sunlight is only in part the cause of the diseases just mentioned, for the skin is more likely to be inflamed and tanned if the exposure take place amidst a large expanse of snow or water. Under these circumstances it has been known to be affected in winter. We are unable to find any one cause that will explain all the cases of skin disease due to exposure.

Apart however from these effects, there can be no doubt that sunlight is beneficial to the human body and mind. We all know that, other circumstances being the same, a sunny summer day is much more exhilarating than a cloudy one. Persons who come from sunny to comparatively sunless climates often experience languor, depression of spirits and loss of appetite; symptoms which many are inclined to attribute to want of natural light. Dr. Hermann Weber says he has seen fever of an irregular type occurring in those who lived in rooms to which little sunlight could come, and there was considerable evidence that the disease was directly associated with the absence of light. Travellers in the Arctic regions attribute to the darkness the great mental depression always felt during the long winter months. The advantages of sunlight are probably derived in some measure from the appreciation of light by our eyes, and also from the well-known chemical properties of sunlight. The large amount of light with which some places are favoured is almost certainly one of the circumstances which make them so beneficial for invalids.

5.—The Rarefaction of the Atmosphere.

People who inhabit regions more than about 6500 feet above the sea-level are said to be pale, sallow, and weak, with a tranquil, and meditative air, and it is stated that the infant mortality is high. It would be well if some physicians whose work takes them to high altitudes would observe how far these statements are correct. It is difficult to say to what these characteristics may be attributed; according however to Jourdanet they are due to the diminution of the pressure of the oxygen in the air. The condition of the inhabitants of such high altitudes is not however of much interest to the physician, because from long residence they are acclimatized, and because for many reasons patients should seldom be recommended to live at such heights.

We will therefore at once pass to the consideration of the symptoms experienced by healthy people who, accustomed to live at or near the level of the sea, subject themselves to a diminution of pressure, either by going up mountains or by making ascents in balloons. Certain of these symptoms, which are only occasionally produced, constitute the *mal de montagne*, and are said to be the following.

The traveller experiences nausea, loss of appetite, and sometimes vomiting. Giddiness, headache, and sleepiness are also usually present. He has a sense of general lassitude and muscular weakness, much greater than can be accounted for by the exertion of ascending the mountain, and this is accompanied by sharp pains in the muscles of the lower extremities, which have a feeling of heaviness. These sensations in the legs have been ingeniously explained by supposing, that in consequence of the diminution of the atmospheric pressure, which helps the muscles to keep the head of the femur in the acetabulum, they have, unaided, to hold the bone in position. The objection to this view is that the atmospheric pressure at the highest point that has ever been attained is still quite competent to keep the head of the bone in its socket. The lassitude affects not only the muscular but also the nervous system. The traveller does not care much what happens to him; he has an anxious expression, and his intelligence is blunted. There can be no doubt that many minor ailments from which travellers suffer are incorrectly set down to mountain sickness; often they are the result of some cause which would have been equally potent to produce them at a low level.

Apart from mountain sickness many important effects are produced on those who ascend to high elevations. Great changes are seen in the respirations. As the climbing is continued they become irregular, sometimes they even temporarily stop, but are on the average faster than in health. After a short time, if the body be kept at rest, they are not appreciably accelerated, but during exertion both the number of them and their depth are increased, much more than they would be by the same exertion at the sea-level. More carbonic acid gas is expired, but it is said to be less than the increase in the number of respirations would lead us to expect: at a very slight altitude the total quantity expired is thought by some to be even a little lessened, whilst there is but little alteration in the amount of expired oxygen. To these changes many authors attribute the exhilarating effect of a short ascent. It is also stated that at a still greater altitude the proportion between the expired oxygen and carbonic acid gas is so altered that the loss of the latter is somewhat greater than at the sea-level, but the loss of the former is very much greater. This is looked upon as the cause of the depressing effect of a very high altitude. There is great doubt whether residence at a mountain station increases the size of the chest in healthy people. Darwin quotes from Forbes that it does, but Jourdanet's experience is to the contrary.

The pulse is invariably quickened; it becomes weak and often dicrotic. The cardiac beats may be more forcible than is natural, and sometimes there is bleeding from the nose.

In a rarefied atmosphere there is naturally more heat lost both by radiation and evaporation than in a denser one. By means of its thermotaxic mechanism the body partially compensates for this. The effect of an ascent upon the temperature of the body has been disputed, but in all probability Drs. Lortet and Marcet are right in saying that if the ascent be very rapid there is at first a considerable fall, but that in a few minutes the body regains its natural temperature. It follows that if the ascent be slow there is no appreciable alteration. The inhabitants at high altitudes suffer from cold.

Dr. Weber made a series of observations upon people who were ascending the Alps, and he summarises his facts thus. In the healthy an elevation of 3,500—5,000 feet caused hunger and thirst, together with a rapid pulse and respiration and a sensation of comfort and ease. At 10,000 feet the heart became irregular and weak, the pulse and respiration more rapid, and some persons fainted.

Jourdanet relates that during a severe storm in Paris, when the barometric pressure was very low, he himself had slight symptoms of mountain sickness, as was shown by his loss of appetite, and general feeling of depression, and, for all we know to the contrary, variations in barometric pressure may produce such effects more commonly than we think.

The height at which the symptoms that have been enumerated first appear cannot be stated definitely, for it varies widely with different people, and their onset is very insidious, but a height of 8,000—10,000 feet is generally necessary before they become marked.

On coming down again to the sea-level even the severest symptoms quickly pass off. When Messrs. Glaisher and Coxwell ascended in a balloon to a height of 29,000 feet Mr. Glaisher fainted, but recovered consciousness soon after the descent began.

It is a most important question whether people can become habituated to a residence at a high altitude, and the answer of those with large experience is that they can. It need hardly be pointed out that the less the height, and the more gradual the ascent the greater the ease of acclimatization. We have seen that at very high altitudes even the inhabitants can hardly be said to be acclimatized, for they are anæmic and lethargic.

6.—Ozone.

Our knowledge of ozone is at present unsatisfactory. Its value in the treatment of disease is not certain, but there is a general impression that it conduces to health. It has great disinfecting power; it is absent, or present in but small quantities in cities; there is less of it inside houses than outside them; it is more abundant in country than in town districts; there is more on the sea shore than inland; and more on mountains than on plains. It is augmented by rainy weather, intense sunlight and thunderstorms.

About the importance of antozone to medical climatology we at present know nothing.

7.—Wind.

The character of the prevailing wind powerfully influences the climate of any place. Winds are classified by Dove into permanent, periodical, and variable.

The permanent are the trade and antitrade winds. In the northern hemisphere the trade wind is north-east, in the southern hemisphere it is south-east. The exact areas over which these blow vary with the latitude, longitude, time of year, presence of land, and many other circumstances which we need not here discuss. On the polar side of the trade winds are the antitrades, blowing in the northern hemisphere from the south-west, and in the southern hemisphere from the north-west, but over the greater part of the world there is more west in them than north or south. At the equator between the two winds is the region of calms, and between the trades and antitrades we also find calms, which are very liable to be disturbed by variable winds and gales. It is sometimes necessary to bear in mind the direction of the trade and antitrade winds, when we send a patient for a sea-voyage, especially if he go in a sailing ship.

The periodical winds are the monsoons: they have no interest for the physician.

There are many winds which fall under the heading ot variable. In most parts of the world where the direction of the wind varies, it usually blows more frequently from one quarter than any other, and this is often useful to know, when choosing a residence for a patient. The following tables compiled by Dr. Hanns show at a glance the relative frequency of the direction of the wind, and the alteration of temperature expressed in degrees Fahrenheit produced by each wind in the northern latitudes.

WINTER.

Mean frequency of the Wind in percentages.

	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.
Western Europe ...	6	8	9	11	13	25	17	11
Eastern Asia	12	7	6	4	4	9	24	34
Eastern N. America	12	11	6	7	9	15	15	25

Average Thermal Variations.

	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.
Central Europe	−5·4	−7·0	−5·8	+2·3	+2·3	+5·6	+4·3	+0·7
Eastern Asia & America	−4·3	+1·1	+6·5	+9·5	+10·4	+7·6	+1·1	−4·5

SUMMER.

Mean frequency of the Wind in percentages.

	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.
Western Europe ...	9	8	7	7	10	22	21	17
Eastern Asia	7	9	17	22	16	10	9	10
Eastern N. America	8	9	7	10	17	23	12	14

Average Thermal Variations.

	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.
Central Europe	−0·2	+1·6	+3·1	+4·0	+3·1	+0·4	−1·8	−1·8
Eastern Asia & America	−3·2	−3·4	−2·9	−0·7	+1·8	+2·2	+0·2	−2·2

In any place where either the temperature, or barometric pressure, or both are very variable, the direction also of the wind will be inconstant, for it is much affected by both of these conditions.

Local winds, which are a division of variable ones, are very influential in forming a climate. The best known are land and sea breezes, and mountain winds. The former are most conspicuous in hot countries. About noon a breeze sets in from the sea towards the land, and dies away at sunset. A little before midnight the land breeze begins to blow in the opposite direction, and is succeeded by a calm towards sunrise. The sea breeze is a damp wind, the land breeze a dry one, and in some climates as southern India and Ceylon, so dry as to be dangerous.

In mountainous regions at about 9 or 10 A.M. the day wind begins to blow up the valleys, freshens till the afternoon, and dies down at sunset. The night wind blowing down the valleys is felt between sunset and sunrise. The origin of these winds is the increased warmth of the air in the valleys during the day, and its consequent ascent. At night, the air left behind contracts, owing to the reduced temperature, and that which is above pours down into the valley to compensate for this contraction.

The character of a wind is modified by a mountain range, for a moist, warm wind, generally from the sea, on arriving at a chain of mountains is forced up and has, in consequence of the higher altitude, to part with much of its moisture. When it begins to come down on the opposite side it is drier and slightly colder. It gradually becomes warmer from its lower altitude, and its compression, and thereby its capacity for containing moisture is increased; that is to say, its humidity is lessened, and by the time it arrives at the plains, it is warm and dry. This is the explanation of the *Föhn* which is felt on the north-eastern side of the Alps; of the parching north-west wind in New Zealand; of the *Sirocco*, which is met with on the north coast of Africa, and comes off the high mountains of the interior; of the *Tramontana*, a northerly, or north-westerly wind coming off the mountains and blowing down the Adriatic; of the *Bora* of Trieste and Dalmatia, a northerly wind from the high plains of Carinthia, and of the *Mistral*, which coming down the Rhone valley sweeps over Provence and the whole of the Riviera. This last is felt most in February, March, and April.

8.—Electricity.

Many people profess to feel lassitude and headaches during or before thunderstorms, but we have no exact information about the effect of the electrical condition of the atmosphere upon the human body. The air is as a rule charged with positive electricity, the earth with negative.

9.—The Soil.

Certain specific fevers are probably related to peculiar conditions of soil. The chief of such diseases is malaria, which is most rife in Spain, Italy, Turkey, Greece, Asia Minor, Persia, Afghanistan, Beloochistan, India, Burmah, the East Indies, parts of China, the southern United States, Central America, the West Indies, the northern parts of South America, most of the African coast except the north and south, and the south of Madagascar. Only those white people whom necessity compels should live in these aguish regions. Many of these may some day be improved by drainage. The natives are able to live with impunity in districts which are death to most Europeans. Invalids of course should not be sent to malarious districts, nor to those in which cholera, dysentery, the plague, or any other specific fever is rife. In all districts infected with these diseases the mountains are either quite healthy, or very much more so than the places at a lower level.

The soil acts powerfully upon the temperature and moisture of the air, for if it be moist the atmosphere is damp and cold, but a dry soil makes the air dry and warm.

The quantity of water in the soil depends upon the frequency with which water is supplied to it, its inclination, and its geological character; those soils having clay or hard rocks under their superficial layer are naturally moist, but on the other hand if they have gravel, sand, or chalk under them they are dry. Those with a great depth of vegetable matter contain much moisture.

The amount of water in a soil helps to control its temperature, for when very wet much of the solar heat is employed in evaporation, instead of warming the earth. It follows that a gravel or sandy soil is warm and dry, but a clay soil is cold and moist, the former taking up but little water, and parting with it quickly, whilst the latter does the reverse.

If there be snow upon the ground, the soil itself is kept warm, and is often warmer than the air. The temperature of the soil and consequently that of the surrounding air is at night regulated by the rapidity of nocturnal radiation. This is hindered in valleys by the surrounding mountains.

As might be expected, when damp land is drained the air becomes warmer and drier; many districts have been rendered healthy in this way.

The capability of damp soils to produce disease is nowhere better shown than in Dr. Buchanan's well-known statistics, which prove that in many towns phthisis much more commonly prevailed when the town was damp than it did after drainage had made it dry; for example in Salisbury, the death-rate per 10,000 from phthisis fell, from 44⅓ before drainage, to 22⅔ afterwards. A careful investigation showed that this could be due only to the drying of the earth. Probably it is because the damp air induces slight attacks of bronchial and pulmonary catarrh that phthisis is more common in damp districts. The dryness of a climate depends largely upon the inclination of the ground, a gravel soil is not necessarily dry if not inclined sufficiently to carry off the water.

10.—Trees.

These play a considerable part in forming some climates. Perhaps they do so chiefly by the protection they afford from cold winds, but they also have other influences.

Considering the great radiation which, at night, takes place from the leaves of trees, and the shade they throw on the ground by day, we can easily understand that, as Ebermayer's observations show, both the soil, and the air are cooler, and the variations of temperature less in forests than in the open; the coolness is by contrast most in the middle of the day, and more marked in summer than in winter. At the same time the humidity of the air is greater in a forest, because being cooler it is more easily saturated, and because the trees prevent rapid evaporation from the damp soil, and collect rain clouds about them. This last point is exemplified in some parts of South America where the rainfall has been so decreased since large numbers of trees were cut down, that laws have been passed to restrict tree-felling. All these effects are naturally more permanent in evergreen, than in deciduous forests.

We know nothing about the value to health of exhalations from trees, but much good is popularly attributed to those from pine trees.

Trees therefore have, as far as we know, no direct effect upon climate, but modify it only by influencing the temperature, the humidity, the wind, and the amount of direct sunlight, all of them conditions which have been already mentioned.

The value of a health resort is often increased by trees, for they enable invalids to sit either in sun or shade, as it may please them.

For further information on climatology consult :—

(1) Weber, Hermann. *Treatment of Disease by Climate. Von Ziemssen's Handbook of General Therapeutics. English Trans. London*, 1885-86.
(2) Jourdanet. *Influence de la Pression de l'Air sur la Vie de l'Homme. Paris*, 1875.
(3) Lombard. *Climatologie Médicale. Paris*, 1877.
(4) R. H. Scott. *Elementary Meteorology. London*, 1883.
(5) Hirsch. *Handbook of Geographical Pathology. New Sydenham Soc. Trans. London*, 1883-86.

CHAPTER II.

CLASSIFICATION OF CLIMATES.

In the last chapter we considered those facts in climatology which are interesting to the physician, and showed how they affect the body; in this we shall classify those climates which are more commonly used as health resorts.

Many classifications have been proposed; but all are open to objections. One of the favourite methods has been to group the climates according to their average temperature, but this is very unsatisfactory because no account is taken of such important factors as the elevation, range of temperature, and moisture. For most purposes the classification of Hermann Weber, and that adopted by Williams, seem most convenient, and the following is based chiefly upon these.

The temperature is always stated in degrees Fahrenheit and the rainfall in inches.

MARINE CLIMATES.

The chief characteristics of these are (1) purity of air, (2) equal and warm temperature, (3) a large amount of moisture, (4) abundance of light, (5) high barometric pressure, (6) over a great part of the ocean permanent trade and anti-trade winds with calms between them, (7) land and sea breezes, (8) abundance of ozone, (9) minute quantities of chloride of sodium, bromine, and iodine in the air.

I.—Those with a Considerable Amount of Moisture.

(*a*). *Cool.*
(Summer Season)

ROTHESAY.—Winter mean T. 39; summer, 58. Rainfall, 40. Rainy days, 150.

(*b*). *Warm.*
(Chiefly Winter Season)

MADEIRA.—Winter mean T. 62. Range for the year, 48-80. Mean daily range, 7-9. Rainy days for the year, 88. November to May, 78. Rainfall, 30. Climate warm, moist, sedative. TENERIFFE with ORATAVA, warmer and drier, and GRAND CANARY much the same, but rather drier.

WEST INDIES, BARBADOS, FLORIDA.—Not enough is known to recommend them with great certainty. Fevers are prevalent. The last two are healthier than the first.

SEA VOYAGE.—Its disadvantages are the lack of exercise, the confinement to the cabin in bad weather, the impossibility of returning if the patient is worse, the possibility of a limit to the fresh food, and sea sickness; but if the voyage be chosen well, it gives all the advantages of a sea climate. Sailing ships are preferable. It is a good trip to leave England in October or November, or earlier if a stay be made, sail to NEW ZEALAND and back, making the voyage six months, so as to return for the English summer. The Cape Horn route and the Suez Canal should be avoided. Another good trip is in the BRAZIL or WEST INDIA Mail Boats. Much good may often be obtained by a voyage to the CAPE OF GOOD HOPE and back.

II.—Those with a Medium Amount of Moisture.

(*a*). *Temperate.* (These have both Winter and Summer Seasons)

PENZANCE, TORQUAY, BOURNEMOUTH, VENTNOR, THE UNDERCLIFF, HASTINGS, ST. LEONARDS, CHANNEL ISLES, QUEENSTOWN.—These are all sheltered from the north, very warm for the latitude. Winter mean T. 39-44. Fairly equal during the day and winter. Rainfall, 22-24. Rainy days, 120-170. Not much sun, frequently overcast, but good hygienic conditions. The other English watering places are chiefly used for their bracing properties in the summer. They are too well known to be mentioned.

BIARRITZ.—Winter mean T. 44; summer, 64. Soil dry and sandy. Good accommodation. Used chiefly in summer, as it is exposed to Bay of Biscay. ARCACHON.—Winter mean T. 44; summer, 68. Rainfall, 34. Rainy days, 103. Extensive pine forests, sandy soil.

HOBART, Tasmania.—Winter T. 44; summer, 62. Rainfall, 23. Rainy days, 110.

(*b*). *Warm.* (Winter Season)

MOGADOR.—Annual mean T. 67, equable. Rainy days, 44. Sky clear; cheerful. TANGIERS.—Winter mean T. 56. Rainfall mostly November and December. ALGIERS.—Winter mean T. 56. Rainfall, 32. Rainy days, 87. Drier than Tangiers. The suburb MUSTAFA is the best part.

Ajaccio.—Winter mean T. 52. Rainfall, 25. Well protected. Palermo.—More exposed than Ajaccio.

III.—Those with a Small Amount of Moisture.

(These are all warm.)

(*a*). *Warm.* (Winter Season) The Western Riviera.—Winter mean T. 47-52. Rainfall, 25. Rainy days, 45-80, mostly during the winter season ; few overcast days, much sunshine, well protected from the north. Direct heat of sun very high, even to 120, hence, great difference between sun and shade. Stimulating and cheerful. Hygienic conditions good. Too many fashionable attractions for bad cases. The *Mistral* may be very disagreeable towards the end of the winter season. The chief towns are Hyères, three miles from the sea, not very well protected from the *Mistral.* Costabelle, St. Raphael, Cannes, Le Cannet, Nice (too exposed to the north), Beaulieu, Cimiez, Monte Carlo, Mentone (the eastern bay is extremely well sheltered), Bordighera, Ospedalatti, San Remo (an exceedingly good health resort, very like Mentone), Alassio.

The Eastern Riviera.—Rather less dry, but not so well sheltered as the Western Riviera. The chief towns are Pegli, Nervi.—Dry and well sheltered. These are the best on the Eastern Riviera Others are Rapello, San Margherite, and Spezzia.

THE SOUTHERN COAST OF TASMANIA, with its capital, Hobart, comes equally well here as in the last list.

(*b*). *Rather Warmer.*
(Winter Season chiefly)

MALAGA.—Mean winter T. 56; daily range very slight. Rainfall, 16½. Rainy days, 40. Well protected from north.

WARM PACIFIC COAST.—The places here are very beautiful and much patronized by Americans. SANTA BARBARA, winter mean T. 54, equable. Rainfall, 16. Rainy days, 17. LOS ANGELOS, SAN DIEGO, SAN JOSÉ. Robertson (*Jour. Am. Med. Assoc.*, 1887) has recently given a full account of this exquisite region, which extends 300 miles north and south of San Francisco. The coast climate, the temperature of which only varies a few degrees day and night throughout the year, extends from 5 to 20 miles inland. The only drawback is that certain parts, especially near Point Conception, are very liable to sea fogs.

THE NORTHERN COAST OF TASMANIA, with its capital, Launceston.—Winter mean T. 53. Rainfall, 28.

LOW LEVEL INLAND CLIMATES.

Many of the places that come under this heading are used chiefly on account of their springs, and will therefore be considered in a subsequent chapter, in which it will be shown that the benefits derived from them are due more to the climate than the springs.

(*a*) *Cold and Dry.* As CANADA; some cases of phthisis have done well in such climates, but at present our information is very scanty.

(*b*) *Warm and Dry.* (Winter Season) CAIRO, and its neighbourhood. Mean T. 52-58. Rainfall, 1·34. Rainy days, 12. Clear sky, long sunny days. Great care must be taken, as the nights are cold. Patients must leave in March, because the hot sandy winds set in after that. HELUAN near Cairo, is very good. UPPER EGYPT is still drier. A voyage up the NILE is very popular, but requires great care on account of the cold nights.

(*c*) *Warm and Moderately Dry.* (Winter Season) These may equally well be described as moderately moist. PAU. Winter mean T. 42-48. Daily range rarely exceeds 16. Rainy days, 119, about 85 in the winter. Elevation 650 feet. Dry soil, very little dust. Sanitary arrangements good. Lovely situation.

ROME. Winter mean T. 50, but very great extremes. Rainy days in winter 65. At times the *Tramontana* is very disagreeable. Is to be avoided during the summer, on account of the malarial fever.

There are numbers of places which are better grouped here than anywhere else, and which are much used in either winter or summer by people who require an invigorating holiday. Such are many places in SURREY and KENT, DARTMOOR, GREAT MALVERN, the YORKSHIRE MOORS, ILKLEY, BUXTON (this is high, elevation 1,000 feet), LLANBERRIS, BRAEMAR, the TROSSACHS, the BRIDGE OF ALLAN, the ARDENNES, many places in the BLACK FOREST, such as FRIBURG and BADENWEILER, the latter being a lovely place, BADEN BADEN, the slopes of the VOSGES, as PLOMBIÈRES.

Rather more elevated are many places on the shores of the LAKE OF CONSTANCE, and VEVEY on the lake of Geneva, and lastly GRASSE, in the Maritime Alps, with an elevation a little over 1,000 feet is an excellent winter resort with much sunshine and protected from the north.

HIGH LEVEL INLAND CLIMATES.

The chief characteristics of these are :—(1) The purity of the atmosphere. (2) The diminished average temperature. (3) The great diathermacy of the air. (4) The high temperature in the sun, together with low temperature in the shade. (5) The high temperature in the day, and the low temperature at night. (6) The great increase of light. (7) The low barometric pressure, and rarefaction of the air. (8) Great diminution of the absolute humidity of the air. (9) Great stillness of the air in winter. (10) High electrical tension of the atmosphere. (11)

Increase in the quantity of ozone. (12) Increased dryness of the soil.

In the previous chapter we have shown in what manner each of these characteristics is likely to influence the body.

The most convenient classification of the high altitude climates is a geographical one. The characteristics are more marked the higher the altitude.

A.—The Alpine High Altitude Health Resorts.

1. *In the Landwasser Valley* (*Winter Season*).

DAVOS-PLATZ.—Elevation above the sea, 5,120 feet. Mean barometric pressure, 25·33 inches. The following table, by Steffen, of the temperatures in the sun and shade in the winter is very important.

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Means of shade maxima	60·4	36·6	39·0	36·0	34·7	36·4
Means of sun maxima	133·0	106.	109.	108·3	111·3	122·3.

Dec. 22nd., 1873, may be taken as an example of a day at Davos. The black bulb thermometer marked at 8.20 a.m., 15 min. before sunrise, – 1; at 8.45, or 10 min. after sunrise, 71·6; at 9.45, 100·2; at 10.45, 103·1; at noon, 108·3; at 1.45, 108·3. The maximum at Greenwich for the same day was 55.

It lies on N.W. slope of a valley stretching from S.W. to N.E., is shut in, and yet not so narrow as to have much shade. The air is very still, the absolute humidity is very low. Snow lies on the ground from the middle of November to the middle of March. There is but little cloud in winter, as is shown by the following table quoted from Lindsay:—

Average number of cloudless and sunny days:—
Oct. 11, Nov. 15, Dec. 16, Jan. 19, Feb. 16, March 17.
Average number of days of alternate cloud and sunshine:—
Oct. 12, Nov. 7, Dec. 8, Jan. 9, Feb. 8, March 8.
Average number of windless days:—
Oct. 14, Nov. 22, Dec. 25, Jan. 25, Feb. 17, March 12.

Average number of cloudy days :—

Oct. Dec. Jan. less than one each. Feb. none. Nov. two. March, one.

Average number of wet and snowy days :—

Oct. 2, Nov. 3, Dec. 1, Jan. 2, Feb. 2, March, 2.

Average number of days on which some snow or rain fell :—

Oct. 5, Nov. 4, Dec. 5, Jan. 1, Feb. 2, March, 4.

DAVOS DÖRFLI :—a mile and a half higher up the same valley; it has the sun half an hour longer each day, but is not so well protected from winds. DAVOS-FRAUENKIRCH, 2½ miles, and WIESEN, 11 miles below Davos Platz, and 4,750 feet above the sea-level are both in the same valley.

2. *In the Engadine Valley* (*Winter Season*).

ST. MORITZ, 6,089 feet above the sea, and MALOJA about the same elevation, a few miles further up the valley. The description of Davos applies to these places, except that being slightly higher, the winter is rather longer, and the mean temperature rather less, but the quantity of sunshine is greater, and there is more wind. SAMADEN, 5,650 feet above the sea, lower than St. Moritz, and more exposed to winds. PONTRESINA, in a lateral offshoot of the Engadine, might be used in the winter if sufficient accommodation could be found.

The places suitable for *summer health resorts* in the Alps are so numerous that no enumeration of them will be attempted here. The main characteristic of all is their altitude, varying from that of the HÔTEL BELALP, with an altitude of 6,700 feet, to places of an altitude of 2,000 feet.

Lower still we have the following suitable for *spring, autumn, and winter health resorts.* VEVEY, on the lake of Geneva, 1,250 feet above the sea, equable climate, protected from cold winds, clear sky and much sunlight. MONTREUX, rather warmer than Vevey. Both these places are celebrated for their grape cures. Aigle and Bex on the Rhone at the foot of the Alps have an equable climate in spring, autumn, winter. Meran, Austrian Tyrol, 1000 feet high, has a warm winter, and is well protected.

B.—German High Altitude Health Resorts.

Görbersdorf. 1,800 feet above the sea, in Silesia, a favourite with the Germans, chiefly to be preferred in the summer; sheltered from the north by hills covered with pine forests. Mean summer T. 57·5. Entirely fair days from May to September, 100; cloudy, 40; overcast and rainy, 15. Falkenstein, in the Taunus, 1,410 feet above the sea, similar to Görbersdorf; both these have good establishments for the reception of patients.

There are many other places of a moderate altitude in Germany, chiefly in the Black Forest, and the Vosges which could very well be used in the summer as health resorts, but they are not available in the winter, nor in the summer for delicate invalids, as they are not well protected, nor have they sufficient accommodation; such are Höchenschwand, 3,313 feet above the sea-level, very bracing, but very exposed, Waldau, 3,149 feet, Schluchsee, 3,118 feet, St. Märgen, 2,920 feet, Todtmoos, 2,690 feet, St. Blasien, 2,428 feet; the last is very popular from its beautiful situation; diligences go frequently to the neighbouring places, such as Höchenschwand.

In the Vosges, the Trois Epis (Drei Aehren), an inn high up just in Germany, has beautiful pine woods near it, and Hohwald is also in a lovely situation.

There are many places in the French Alps and Pyrenees which might no doubt be used as high altitude health resorts, but at present not enough is known about the winter winds, nor is there any accommodation for invalids.

C.—African High Altitude Health Resorts.[1]

THE ORANGE FREE STATE, especially its capital BLOEMFONTEIN, 4,750 feet above the sea, KIMBERLEY in Griqualand West, and the TRANSVAAL have all a high altitude, are cool, dry and clear. Although these districts are becoming more and more accessible by rail, they are so far from England, the accommodation for invalids is so poor, and we have so few statistics concerning their climate, that only the comparatively strong can be sent there. Some vigorous persons who have had a few slight signs of phthisis have derived benefit from making excursions into the interior in a bullock waggon.

D.—Asiatic High Altitude Health Resorts.

THE HIMALAYAS must contain many health resorts, but at present they are used merely in order to enable their visitors to escape from the malarial influences of the plains. We do not know enough about them to name any particular places which are beneficial on account of their altitude.

E.—Australian High Altitudes.

There are no winter stations in the mountains, but MOUNT VICTORIA in New South Wales, and MOUNT MACEDON in Victoria, are used by the inhabitants of Sydney and Melbourne respectively in the summer. The DARLING DOWNS in New South Wales include the undulating plain between Queensland and the Murray. Almost all this is pasture. There are very few trees, and only about 10—14 inches rainfall. The summer is hot, T. about 110. The air dry, generally still, cloudless, and much sunshine. The climate is at its best in the winter, autumn and spring.

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[1] Symes Thompson, *South Africa as a Health Resort.* London, 1889.

F.—The High Altitudes of the Rocky Mountains of Colorado and New Mexico.

MIDDLE PARK, 8,000—9,000 feet above the sea. There are hot sulphur springs here, and a hotel. IDAHO SPRINGS, 7,700 feet above the sea. There are hot soda springs, mineral baths, and hotel accommodation. BOULDER, a town with 3,000 inhabitants, a seltzer spring, and a hotel. The waters are ferruginous. ESTES PARK, 7,500 feet above the sea, about ten square miles in area, beautiful scenery, numbers of pine trees, and a hotel. MANITON SPRINGS, 6,370 feet above the sea; this is a well-known health resort, with mineral springs. COLORADO SPRINGS, 6,000 feet above the sea; a small town, with wide and shady streets. CAÑON CITY, 4,500 feet above the sea, is protected from the northerly winds, and has springs with water like Vichy water. DENVER, 4,350 feet above the sea, a large, well-built, airy, prosperous city. Mean annual temperature, 48·6, mean in December and January, below 32; in July, 72·5; mean daily range, 28; extremes, 54; amount of rain and snow, 16 inches; rainy days, 68, of which 40 have snow. Thus we have a moderate, variable temperature, with low humidity and many clear days. Near Denver, but at a higher altitude, are the MONSON springs, where there is very good accommodation. Fisk, in a recent number of the *Boston Medical and Surgical Journal*, gives a very full account of Denver and Colorado generally, and shows that the district has the great advantage over the Swiss stations, that there is much more sunlight each day. Taking into consideration the social and climatic conditions, some of the towns in Colorado appear to be excellent high altitude health resorts. PUNCHA SPRINGS and WAGGON WHEEL GAP have only moderate accommodation.

SANTA FÉ, 7,000 feet above the sea, in New Mexico, has a delightful climate, and will probably become an important health resort, but this and other New Mexican places are as yet not much known.

G.—Other Places of High Altitude in the United States.

These are not so high as the last, and might perhaps be better classified as medium altitude stations. The best known is Asheville, in North Carolina, altitude 2,250 feet, with summer mean T. 70·7, winter mean 37·8, a moderate daily range, and a rainfall of 40 inches. There are many sunny hills in the neighbourhood. Aiken, in South Carolina, 565 feet above the sea, and Thomasville, two miles south, with an elevation of 330 feet, have been recently recommended as good medium altitude stations (*Annual of Univ. Med. Sc.* vol. v. 1888).

The state of Minnesota, with an average altitude of 1,100 feet has but poor accommodation.

The Cumberland Table Land, in Eastern Tennessee, especially Walden's Ridge, has been recommended. Altitude 2,000 feet.

In Texas there are Boerne, Fredericksburg, Fort Clarke, and the valley of the Rio Grande, with a medium altitude of 1,500—2,000 feet. Further north is Western Kansas, and the buffalo grass prairie, with an elevation of about 3,000 feet.

The Mesilla Valley, in Southern New Mexico, has a fine dry climate, with much sunshine and a moderate elevation.

H.—High Altitudes of the Andes of South America.

Here are very elevated regions of perpetual spring, where sowing and reaping go on at the same time; they are warmer and more equable than the Rocky Mountains, and there is often a mean temperature at all seasons of 60. They are dry and bracing. Santa Fé di Bogota (United States of Columbia), 8,650 feet elevation, Quito (Ecuador), 9,540 feet elevation, Arequipa (Peru), 8,000, Janja and Huancayo (Peru), 10,000, the banks [illegible] River where the average temperature all the year round is 50—63, the sky always clear and sunny, and the atmosphere bracing, the Montana, the central portion of Peru, 12,000 feet elevation, with Cuzco, the ancient capital, Lake Titicaca, between Peru and Bolivia, 13,000 feet elevation, with towns on its shores, Potosi (Bolivia) 13,300 feet high, and San Paulo in Brazil, 2,300 feet elevation, where the air is very dry, are some of the best known places.

I.—High Altitudes of Central America.

The Anahuac, the plateau in Southern Mexico, with the city of Mexico on it, has an elevation 6,000—8,000 feet. It is the only part of this continent that can be used by invalids, but at present we have very little information about it as a health resort.

CHAPTER III.

TREATMENT OF DISEASE BY CLIMATE.

In the last two chapters I have indicated the factors which form a climate, their effects upon those in health, and the climatic characteristics of the various health resorts: it remains to consider what are the diseases which may be advantageously treated by such characteristics.

Phthisis.

Treatment by High Altitudes.—The following are the distinguishing features of the climate of high altitudes, and each of them is probably beneficial for phthisis.

(1) Purity of the Air. When we consider the wide prevalence of phthisis in cities, crowded barracks, &c., it is obvious that a pure atmosphere is desirable.

(2) The Temperature. The clearness and stillness of the air at a high altitude render its diathermacy great; hence, as the figures already given for Davos show, the temperature in the sun in the depth of winter is sufficiently high for patients to sit out of doors. This is clearly good for them, because in most varieties of the disease they should be in the open air as much as possible.

(3) Increased Dryness of the Atmosphere. For the majority of cases this is extremely favourable, probably by diminishing the liability to bronchitis. The exceptions to this

statement will be considered presently. The proof of the value of a dry air is seen in the fact that stations at a great height which are moist are of no use for phthisis, and extensive observations recently made by Dr. Pepper in Pennsylvania have confirmed those of Bowditch and others, that the amount of phthisis in any district bears a direct relation to its humidity.

(4) INCREASED LIGHT. This is probably owing to the absence of clouds, and moisture. That it is desirable for phthisis, as well as for most other diseases, there can be no manner of doubt.

(5) INCREASED QUANTITY OF OZONE. Considering its powerful disinfecting qualities, and its association with purity of air, it is probable that this aids recovery from phthisis, although we have no certain evidence on the point.

(6) THE WIND. The air is very still at high altitudes especially during the winter, and all mountain health resorts are so chosen as to be protected from the prevailing cold wind. Thus the liability to bronchial attacks is diminished, and the cold is not felt nearly so keenly as it otherwise would be.

(7) THE DRY SOIL. Either from its inclination, or because it is snow-covered, or from the little rainfall, the soil at a high altitude is usually dry. The figures already quoted show how much more common phthisis is upon damp soils than upon dry.

(8) THE ALTERED ELECTRICAL CONDITIONS. Some authors have thought that these aid recovery in phthisis, but we do not know whether this is true.

(9) THE DIMINUTION OF BAROMETRIC PRESSURE AND CONSEQUENT INCREASED RAREFACTION OF THE AIR. This is given last partly because it is thought by some to be the most important, and partly because many of the characteristics already mentioned depend upon it. Most observers are agreed that many phthisical patients are considerably improved, and even cured by residence at mountain stations, but the ultimate

cause of this is not certainly known. Much of the good derived is due no doubt to the other distinguishing features of high altitudes which have just been mentioned, but as the cases do much better at an altitude than on the sea-level, even when the climatic conditions are similar, the height itself probably plays a large part in the resulting improvement.

It is often urged as a reason why elevated regions are beneficial for phthisis that the inhabitants there suffer but little from it. This is not a cogent argument, for it does not follow that conditions which prevent a disease can cure it.

Many of the effects of high altitude mentioned in Chapter I. appear at first sight to be directly prejudicial to sufferers from phthisis. For example, the appearance of the permanent inhabitants, and the *mal de montagne*, seem to show that high altitudes must be injurious. Owing also to the rarefaction of the air, actually less oxygen is taken in at each inspiration than at a low level, although against this must be set the fact that more carbonic acid gas is given off. But with regard to all these disadvantages it must be borne in mind that some persons, especially if the ascent be gradual, can easily accustom themselves to altitudes of as much as 10,000 feet, such as have been recommended in Peru, and that the usual elevation of health resorts is under 6,000 feet, which is hardly high enough to cause bad symptoms which will be felt to a serious degree.

The physiological effects to be observed in people making moderate ascents, such as those to Swiss stations, are even still disputed. They have been already mentioned, but some of them may be briefly recapitulated, with especial reference to phthisical patients. They are of course the same in other places than Switzerland, provided that the climatic conditions are similar.

It appears, according to the majority of observers, that at first the pulse and respiration are slightly quickened, but that they return, in a period varying from a few days to a few weeks to their normal rate: some authors state that they are permanently slowed. The relative proportion of blood in the skin and lungs is disputed; some maintain that the lungs being subjected to less pressure contain more blood, whilst Jaccoud says that they are to be looked upon as internal organs, and that more blood goes to the skin, and less to the lungs. The expansion of the chest is also disputed. Many authors believe that it occurs: for example Dr. Theodore Williams says he is sure that residence at a high altitude increases the size of the thorax in phthisis and some cyrtometric tracings which he gives are very striking. Certainly those who maintain the opposite view are in a minority. Much stress is laid on the importance of this expansion, for it enables every possible portion of the lung to open out, as owing to the diminution of pressure its elasticity is able to act more freely. It is also stated that the increased size of the chest leads to emphysema, and that this is an advantage, which is however very doubtful. With a phthisical patient the effect of altitude upon the appetite is various, it may lead to absolute disgust of food, but in the majority of cases it promotes hunger. As most of these patients have poor appetites, and are thin and wasted this result is most desirable. Sleep is often at first disturbed, but commonly the patient ultimately becomes accustomed to the new surroundings. The energy and muscular power are augmented.

I have attempted to show the many ways in which it is possible that a high altitude may relieve the sufferer from phthisis, but quite admit that it is hard to indicate with certainty the cause of the benefit in any case; but that it follows is according to most writers undoubted. Dr. Theodore Williams, in a paper recently read before the *Royal Medico-Chirurgical Society*[1] brought forward an account of 141 cases treated by residence on the Alps; of these 74·8 per cent. improved (including arrest of the mischief in the lungs in nearly 44 per cent.) 3·5 per cent. were stationary, and 21·5 per cent. deteriorated.

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[1] *Medico-Chirurg.* Trans. Vol. lxxi.

In the debate which followed, the greater number of the speakers were in favour of treatment by high altitudes, but Drs. Quain and Pollock were not convinced that it did much good. In the *Lancet* for September 15th, 1888, Mr. John Lowe, a surgeon, gives an account of the good progress he made when he went to Davos. He had unmistakable phthisis, with bacilli in the sputum. He contrasts his own case with that of his two sisters who were treated in England and died.

With regard to the time of year at which to arrive in the Swiss Alps, the best is September, so that the patient may get acclimatized before the snow falls in November. His sojourn there should last from six months to some years, and he should be very careful how he changes to a lower altitude. In most cases rather than do this he should, when tired of one mountainous part, go to another; thus he might spend the winter at Davos and the summer in the Engadine. The time of arrival is of much less importance in places below the snow line, such as the Highlands of Africa, the Andes, and the Rocky Mountains. Many most surprising cures have been recorded for each of these districts, and they are to be thoroughly recommended if patients are fit to go the distance, to camp out if necessary, and to put up with the primitive accommodation.

In all cases it is advisable to make the ascent gradually; for instance, the patient should not go to Davos at once; but he might previously spend some time at intermediate stations, say first of all at Badenweiler, Falkenstein, Göbersdorf, Vevey, or some other place at a medium height. About September he may arrive at Davos: the same precaution should be observed on leaving. If it should seem desirable to send a patient abroad in the middle of winter, he should not then go to a place as high as Davos, but should spend the rest of the winter at an intermediate station.

It is of such importance that only suitable cases should be sent to high altitudes, that we must point out those that are unsuitable:—

Firstly—Those in whom there is considerable affection of the bronchial tubes, for the dryness of the climate increases the kind of bronchitis which commonly accompanies phthisis.

Secondly—Patients with much emphysema or bronchiectasis, because of the probably diminished absorption of oxygen, and the difficulty of respiration experienced on first arriving.

Thirdly—Patients with disease of the heart must not go to a high altitude, because of its effect upon the pulse and upon respiration.

Fourthly—Cases liable to acute febrile attacks, whether or not these indicate an occasional increase of mischief in the lungs, should remain on a low level.

Fifthly—Patients who are very excitable, or suffer from insomnia should not go, for we have seen that a visit to a place at a great elevation promotes these symptoms. Women do not acclimatize so well as men.

Sixthly—Ulceration of the larynx and intestine are both of them contra-indications.

Seventhly—Cases in which there are very extensive lesions, or which are very advanced are unsuitable.

Eighthly—Pneumonic phthisis, if at all acute, is made worse by a high altitude.

Ninthly—Patients who cannot take exercise should not go.

Tenthly—The very old and the very young had better be treated at home.

Eleventhly—Sir Andrew Clark (*Lancet*, Jan. 5, 1889) states that patients who go to Alpine health resorts suffering from albuminuria, or those who develop it whilst there seldom derive any good from their change.

There are many conditions which have been thought to contra-indicate this treatment, but which do not, and they had therefore better be mentioned. They are :—

Pulmonary Hæmorrhage.—It is now known that this, so far from being a contra-indication to treatment by high altitudes, is actually relieved by it. The exact explanation cannot be given.

Fever.—If this is not excessive, and if it does not indicate any active changes in the lungs, it is often improved.

Simple Diarrhœa and simple Dyspepsia.—These are both of them benefited.

Night Sweats.—There is a common belief that these forbid this treatment; on the contrary, they often disappear on removal to a high altitude.

The presence of Cavities.—This is not a contra-indication unless a very large area of lung is destroyed.

There is no need after these two lists to say what cases are suitable for this climatic treatment; it may however be observed that those in which there is threatened phthisis with a strong hereditary predisposition, and those of imperfect thoracic development, are much benefited. According to most authorities it cannot be too strongly urged that so long as the condition and disease of the patient allow the reverse indications to be neglected, a mountain climate should be tried.

Treatment by Low-level Climates.—There are two classes suitable for phthisis, the warm and moist, and the warm and dry.

WARM AND MOIST CLIMATES, of which Madeira and a sea voyage are types, are best adapted for patients with much acute change in the lungs, or bronchi. We have seen that the sea moderates the variations of the temperature of the air, so that on board ship diurnal differences are slight; a circumstance which is clearly favourable. The voyage, which is preferably taken in a sailing ship, should be arranged so as to avoid the cold seasons. These climates are sedative, and may therefore be advantageously used for phthisical patients of an excitable and nervous type and for those who suffer from insomnia. If only a moderate degree of moisture is required, places classified as having a medium or small quantity of it, such as the Riviera, may be tried.

WARM AND DRY CLIMATES are to be recommended if some condition prevent the patient from going to an altitude, and the soothing influence of a warm and moist climate on the lungs and mind is not required. For example, a sufferer from phthisis who has either disease of the heart or albuminuria, but no other complication may be sent to Egypt.

As we have given the characteristics of the climates, and a classification of them, together with the principles that guide our selection in phthisis, we can only leave each case to be judged on its own merits. It should be borne in mind that unless some circumstances forbid it, a mountain climate is probably the best, and that if the disease be very advanced the patient should be kept at home.

Chronic Bronchitis.

It is clear that if there be but little secretion the best climate is one which is warm and moist, while on the other hand if there is much secretion a warm dry climate is preferable. The variations between these two extremes will be determined in each case by the amount of secretion. Above everything a variable climate like that of England, especially in the winter, must be avoided. The same remarks apply to laryngeal catarrh. Emphysema and bronchiectasis should be treated in the same way as bronchitis, of which they are complications. A moderate elevation, as that of Badenweiler, for a summer resort does no harm in these cases.

Pleurisy.

To aid the absorption of fluid a warm, dry, low-level climate is best, for the warm, dry air will, by the diaphoresis it causes, accelerate the absorption of the fluid in the pleural cavity, and the low level will render respiration as easy as possible. Cases of imperfect expansion of the lung after pleuritic effusion should be sent for some months to places high up in the mountains, inasmuch as increased expansion of the wall of the chest is desired.

Asthma.

This disease often improves at a high altitude, but if there be bronchitis, the height must be sufficiently moderate to enable the patient to get some moisture and warmth.

Bright's Disease.

When acute renal disease threatens to become chronic, Dr. Johnson recommends residence during the winter at warm dry and equable climates, such as Cannes, Nice, Mentone, or Algeria. He also advises long sea voyages. Chronic renal disease is also much benefited by a dry warm climate such as that of Egypt, for there the skin is in the most favourable condition for perspiring freely, and the risk of pulmonary complications is reduced to a minimum.

Dyspepsia.

Dyspeptic patients frequently complain of coldness, which is greater after a meal, because the blood collects in the abdominal viscera and leaves the skin. The climate chosen for them must therefore be warm, and it should be one that permits of exercise. Dry warm stimulating climates are to be recommended, especially those at a high altitude, unless age contra-indicate them, or they produce insomnia, or increased dyspepsia. Wherever the patient goes he must keep warm; this is easily managed even in winter in any place where the diathermacy of the air is great as in Davos. If an elevated place does not suit, a dry warm seaside climate must be tried; but if the indigestion becomes worse, resort must be had to a warm dry inland situation. There are many cases of dyspepsia which resist all treatment save a long sea voyage.

Gout.

The climate chosen for the gouty patient must always be one likely to improve his digestion, and as far as possible warm and dry, as he is very liable to chronic Bright's disease.

Cardiac Disease.

From what we have said about the effect of elevation on the circulation, it follows that altitudes much over 1,000 feet are harmful. As will be shown in Chapter V., the climate ought to be one which allows the patient to take moderate exercise. No risk should be run of producing bronchitis. As a rule inland climates are preferable to littoral.

Mental Disease.

These cases vary so much that each must be judged on its own merits, but the following general principles should guide us in forming a decision. As Dr. Savage has pointed out, many patients, especially those who are acutely affected, require mental rest, and this may be provided by a sea voyage. Persons afflicted with hypochondriasis, or mental depression, need to be taken out of themselves. A sea voyage is too monotonous. Travelling about to places that are likely to arouse interest, such as Rome and Florence, will probably be better. Most sufferers from mental disease require plenty of exercise. Cases of depression will benefit by mountain climates, which will however be harmful to those who are excitable.

Neurasthenia.

Patients who are exhausted, by excess of mental work or anxiety, ought to be treated in the same way. Many such fall nowadays under the heading of Neurasthenia. Beard in his treatise on this subject teaches the great value of climatic treatment. The health resorts are to be chosen on principles similar to those recommended for mental cases, always bearing in mind the great value of a mountain climate for patients who can stand it.

Malaria.

Many people who have suffered from malaria remain weak and anæmic, and have occasional fits of shivering, after they have left the malarious district; for such, mountaineering is to be strongly recommended.

Neuralgia.

Neuralgia should be treated in the same way as any disease which may cause it, and therefore the climates should be those suitable for rheumatism, gout, dyspepsia, or malaria, as the case may be.

Chlorosis.

Those suffering from this disorder do not absolutely require, but will probably benefit by, a climate that will stimulate digestion, and all the functions of the body. Warm moist situations must be shunned, and mild bracing sea-side places, medium altitudes, or yachting in temperate waters should be advised. Wherever the patient goes she must be kept warm.

Chronic Catarrh of the Bladder.

Dr. Weber recommends dry warm equable climates and sea voyages.

Convalescence from Disease.

The recovery from continued discharges of pus such as are met with in hip disease or empyæma is accelerated by a long stay at the sea-side, where it is sufficiently warm to allow the patient to enjoy much fresh air. A change to some bright warm country place, preferably by the sea, greatly aids convalescence from any acute disease; but the weakness of such patients should be recollected, and a place having plenty of comforts and easy of access must be chosen. For further information about convalescence, the reader is referred to the Chapters on Diet, and also to Chapter XXIII.

Various other Conditions.

The weak, anæmic, poorly developed, children so frequently seen in towns, and also those who would formerly have been called scrofulous are usually marvellously improved if they are sent to stay a long time at some place similar to those recommended for patients suffering from hip disease, or if this be impossible nearly every place in the country is better than a town.

The pallor, indigestion, and other anæmic symptoms often seen in girls, but sometimes in boys, disappear upon a change of climate, similar to that already recommended for chlorosis. The disorders of the climacteric period in women are also benefited by the same treatment.

Warm sunny dry climates, not much above the level of the sea, are suitable for cases of senile decay.

Many places which are in reality climatic health resorts will be described in Chapters VIII. and XI.

For further information on treatment by climate consult:—

(1) Weber. *Treatment of Disease by Climate.* Von Ziemssen's *Handbook of General Therapeutics. English Trans., London,* 1885-86.
(2) Williams, C. J. B., and Williams, C. Theodore. *Pulmonary Consumption: its Etiology, Pathology, and Treatment. London,* 1871.
(3) Jaccoud. *The Curability and Treatment of Pulmonary Phthisis. Trans. by M. Lubbock, M.D. London,* 1885.

(4) Burney Yeo. *Health Resorts and their Uses. 2nd Edition. London,* 1885.
(5) Archibald Smith. *Dublin Quar'erly Journal, May,* 1886.
(6) Denison. *Rocky Mountain Health Resorts. 2nd Edition. Boston,* 1881.
(7) Lindsay. *Climatic Treatment of Consumption. London,* 1887.
(8) Williams, C. Theodore. *On the Results of the Treatment of Pulmonary Consumption by Residence at High Altitudes. Med. Chirurg. Trans.,* vol. lxxi.
(9) Williams, C. T. *Influence of Climate on the Prevention and Treatment of Pulmonary Consumption. London,* 1877.

CHAPTER IV.

TREATMENT BY COMPRESSED AIR.

THE respiration of air at a pressure differing from that of the atmosphere may be performed in one of two ways. Only that which is exhaled or inhaled may have a pressure unlike that of the atmosphere, or the whole body may be surrounded by air whose condensation or rarefaction is abnormal. This is sometimes spoken of as an air bath. We will first consider the former of these methods.

Inhalation of Air at an altered Pressure, that surrounding the Body being Normal.

The patient may inspire air at either an increased or diminished pressure, and he may expire into air of a density either greater or less than normal. The only arrangement about which anything is known is that of inspiring condensed and expiring into rarefied air, and all the remarks which follow refer to this process.

According to Oertel the effect of inspiring compressed air is to dilate the thorax and lungs to their utmost, collapsed alveoli are distended, and air passes easily into tubes narrowed by mucus, or swollen mucous membrane. Some blood in the pulmonary capillaries is pressed out of them and thrown back on the general circulation. It commonly takes two or three respirations for the condensed air to reach the furthest air cells. It is difficult to see, however, as the walls of the chest are not transparent, how Oertel knows that the above consequences ensue. The pressure employed is usually greater than normal by $\frac{1}{80}$ to $\frac{1}{40}$ of an atmosphere.

The expiration into rarefied air, the diminished pressure of which is generally $\frac{1}{80}$ to $\frac{1}{40}$ less than that of the atmosphere, leads to a very complete emptying of the air from the lungs. The expiratory forces are increased, and consequently the strength of the next inspiration is augmented. Owing to the diminution of pressure in the alveoli, the pulmonary capillaries are well filled with blood. By the inhalation of compressed air more oxygen is conveyed to the alveoli than normally, whilst by the exhalation into rarefied air more residual air, and hence more carbonic acid gas is got rid of than is usual; therefore the total result of inspiring compressed, and expiring into rarefied air, is to greatly favour the exchange of gases. It also aids the elasticity of the lung tissue, and the play of the muscles of respiration. The spirometer shows that, if the treatment be carried out every day for some time, the increase of vital capacity, and of the inspiratory and expiratory forces is maintained for a considerable period after its discontinuance; but deductions drawn from the employment of the spirometer are always open to the objection that the knack of using it, and therefore the registration of a high breathing power, can be acquired by practice. This treatment occasionally leads to catarrh of the bronchial mucous membrane, a difficulty which may be overcome to some extent by warming the air, or by mixing volatile sedative substances with it.

Oertel advises the employment of this method for the following conditions. (1) *Asphyxia* of all sorts. (2) *Chronic bronchitis.* In this disease he advises that the air should be warmed or medicated, and that there should be from one to four sittings a day of about fifty respirations each. The increase in pressure of the compressed air, and the diminution of the rarefied should each be somewhere between $\frac{1}{80}$ and $\frac{1}{60}$ of the normal atmospheric pressure. (3) *Emphysema.* The inhalation of compressed air by those who suffer from this disease must be conducted with caution, and the additional pressure should be slight. The expiration into rarefied air is the more valuable of the two parts of the treatment, which often extends over weeks. (4) *Pleurisy.* The inspiration of condensed air aids the absorption of fluid, after the withdrawal of which it will bring the pleuræ together, will prevent the falling in of the wall of the chest, and will help to expand the lung after the formation of a fibrinous layer on the visceral pleura. The pressure of the air inhaled should be greater than normal by $\frac{1}{30}$. The exhaling into rarefied air is of but little value. (5) *Badly formed phthisical chests.* (6) *Early phthisis* in which there is not much inflammation.

The treatment should not be undertaken in acute affections of the respiratory mucous membrane or lungs, in advanced bronchiectasis, or in any condition, such as Bright's disease, in which it is undesirable to raise the general blood pressure.

For a full description of the various forms of apparatus the reader must consult Oertel's work. Dr. C. T. Williams considers them all unsatisfactory, for the application of the mask to the face is very irksome, and in most of them the patient must re-breathe the same air that he has just expired. This mode of treatment has never been very popular, and does not seem to be so valuable as air baths.

Inhalation of Compressed Air by which the whole of the body is surrounded.

Bridge builders, divers and others, who work in an atmosphere the pressure of which is considerably in excess of the normal, suffer from symptoms the chief of which are paralysis of the lower extremities, and of the bladder and rectum, hæmorrhage from the nose and lungs, dyspnœa, and coma. These need not however be considered here, for they are due not to the compressed air, but to the sudden exodus from it, and furthermore such great pressures as these occupations entail are never employed in medicine.

Compressed air is applied therapeutically by means of air-tight rooms into which air at the required pressure is pumped; these are called pneumatic chambers, are comfortably furnished with chairs, &c., have windows or artificial light, and a means of communication with the outside such as a telephone or electric bell. In England there is one in London at the Brompton Hospital, and an excellent description of it by Dr. C. T. Williams may be seen in the *British Medical Journal* for April 18, 1885. Others are to be found at Ilkley, Ben Rhydding, Paris, Brussels, Berlin, Zurich, Stockholm, Milan, Wiesbaden, Ems, Reichenhall, Nice, and lastly at Simonoff's establishment at St. Petersburg, which is the most complete and luxurious of them all.

An increase of pressure of from $\frac{2}{5}$ to $\frac{2}{3}$ of an atmosphere is usually employed. Anything beyond this is unnecessary, and liable to produce disagreeable symptoms.

A healthy individual when he passes into air at the above pressure becomes conscious of noises in the ears, earache, and a sense of obstruction in the tympanic cavity. This is due to the greater difficulty which the air experiences in passing up the Eustachian tube, than along the external auditory meatus, so that at first the tympanic membrane is pushed in. These symptoms are much relieved by repeatedly swallowing, for this facilitates the opening of the Eustachian tube. As soon as the pressure on both sides of the membrana tympani is equalized, these aural symptoms pass off, but return in a lesser degree on leaving the pneumatic chamber, for then the membrane is pressed outwards. Both C. T. Williams and Von Vivenot have detected a rise of tone in the voice. General sensibility, and the senses of smell, taste and touch, are impaired, and very frequently a soporific condition is induced. Experimenters are unanimous concerning the respiratory variations. The most noteworthy of them is that the compressed air chamber increases the amplitude of the respirations and the pulmonary capacity; Von Vivenot makes it as much as 3·3 per cent., and Paul Bert as much as 7·0 per cent. As a result the upper limit of the hepatic dulness descends, the area of cardiac dulness is diminished, and the sounds of the heart become indistinct. The respirations are fewer, in a healthy person their rate falls to fourteen, twelve, or even less per minute; but if emphysema is present the decrease is greater, for they often fall from thirty or forty to the ordinary number. Breathing is carried on more smoothly, and laboured respiration becomes tranquil; inspiration is particularly easy and is shortened, but expiration is prolonged. If the baths be taken daily for some time, these results continue for a long while, even many months after they are left off. The blood is driven out of those organs with which the air comes directly in contact, and therefore a rabbit's ear becomes pale and white. The pulse is small and somewhat less rapid than normal. The œdema and vascular distension connected with laryngeal, pharyngeal, and bronchial catarrh diminish. Observations made under the pressure commonly employed in air baths have shown that there are considerable changes in nutrition. Slightly more urine is passed. Pravaz in 1875 first demonstrated that the amount of urea excreted is excessive, and Paul Bert and others have proved that more oxygen is taken in and more carbonic acid gas is given off. The appetite is stimulated, and most persons weigh more after a course of baths than they did before.

We have seen that sudden alterations in pressure produce dangerous symptoms: it is therefore necessary that the variations should be gradual. If a sitting is to last two hours the first half hour should be spent in slowly increasing the pressure to the desired maximum, at which it may remain for an hour, and during the last half hour it ought to be gradually diminished to that of the atmosphere. The bath should be taken every day or every other day. Those first given should be of air very little condensed. Day by day the condensation should be greater till it is from $\frac{2}{5}$ to $\frac{2}{3}$ of an atmosphere in excess of the ordinary atmospheric pressure.

The following conditions have been treated by it :—

Pulmonary Emphysema.—The pneumatic chamber has given more favourable results in this than in any other affection for which it has been tried. Dr. C. T. Williams has published some striking cases illustrative of the benefit to be derived from the use of compressed air. After several baths the patient, if the results are favourable, breathes more easily, his dyspnœa, cough and expectoration are lessened, the respirations are slower and deeper, the cardiac and hepatic dulness reappear, as well as the breath sounds. The girth of the chest diminishes, but at the same time, the vital capacity is increased. The exact reason of this improvement is disputed, but Simonoff, Oertel, Williams, and others are all agreed that it takes place, provided that the condition of the lungs is not secondary to serious disease of other organs. The duration of the treatment varies much, but on the average about thirty baths of two hours each are sufficient.

Bronchitis.—The chronic variety is, according to some, favourably treated by the pneumatic chamber, but it is difficult to dissociate chronic bronchitis from its accompanying emphysema. The treatment has usually to be prolonged over several months.

Acute Laryngeal and Bronchial Catarrh.—These disorders are said to yield very quickly to treatment by compressed air, but before we can form a definite opinion more evidence is required. It is thought that the influence exerted is mechanical upon the swollen mucous membrane and vessels. An average of three or four sittings is recommended.

Asthma.—This term is mostly used in a very loose way, meaning almost any variety of paroxysmal suffocative attacks. These may be due to diseases of the lungs, or may be primarily neurotic; in the latter case they are described as essential asthma. The paroxysms of dyspnœa which occur frequently in essential asthma are very prone to give rise to emphysema, so that the case which was originally purely a neurotic asthma becomes very like one of bronchitis and emphysema with asthma-like attacks of dyspnœa. Most authorities, as, for example, Dujardin-Beaumetz, consider that the only value of a course of baths in the pneumatic chamber is to relieve the emphysema when it complicates primarily neurotic asthma, or to relieve the bronchitis and emphysema if they are primary, and so to diminish the frequency of the accompanying asthma-like attacks. Oertel agrees with this, but thinks that the method also reduces the swelling of the bronchial mucous membrane which so often complicates asthma. Dr. C. T. Williams however considers that the spasmodic form is also alleviated, and he quotes a striking case in point in which the patient was very much better after a series of seventeen baths.

Phthisis.—Compressed air has been stated to do much good in this disease by opening out every portion of the lung, and increasing the appetite and general nutrition. It is indicated when there are present feeble health, and an ill-formed chest, without any phthisical signs in it—conditions so common in people with a strong phthisical tendency. It is stated also to be particularly serviceable for cases accompanied by an increased secretion from the bronchial tubes, but if much consolidation is present there is little likelihood of benefit. Slight pulmonary hæmorrhage need not prevent our giving the bath a trial, but the transitions in pressure must be gradual. Oertel gives as the contra-indications, high fever, great weakness and emaciation, general tuberculosis, softening and excavation sufficient to make the rupture of a cavity or blood-vessel probable, or decomposing processes in the lungs and bronchi, because the resulting putrid matter is liable to be absorbed. It is impossible to make any dogmatic statement concerning the advantages of compressed air for phthisis. Before doing so we must have many more observations, but the prevailing opinion is that it is only worth recommending to patients in the first stages, for whom the pulmonary gymnastics it induces will probably be valuable.

Chlorosis.—Dujardin-Beaumetz regards the compressed air bath as of great use in this condition because of the increased appetite and metabolism set up by it. This is one of the first disorders to which the method was applied.

Whooping Cough.—Many have tried it for this disease, and all who have done so report favourable results.

Pleurisy.—It has been warmly advocated for this malady, but although at first sight it would seem that the greater extent of respiratory movement might be very favourable to the expansion of the lung after the absorption of fluid, clinical evidence is so conflicting that we cannot determine whether the method is of any value.

Diabetes and catarrh of the middle ear have both been treated by the pneumatic chamber, but not extensively enough for us to know if it be advantageous.

It is generally stated that compressed air is undesirable for persons with diseases of the internal organs, other than those of the lungs, because the blood being driven from the pulmonary vessels to the other viscera will lead to congestion of them.

It is not yet known whether the good results of compressed air last for the patient's lifetime, but the experience of many physicians is that they endure a long while.

The effects of rarefied air are fully dealt with in Chapters I. and III.

For further information consult:—

(1) C. T. Williams. *Lectures on the Compressed Air Bath and its Uses. Brit. Med. Journal, May* 9, 1885.
(2) Oertel. *Respiratory Therapeutics. Von Ziemssen's Handbook of General Therapeutics. English Trans., London,* 1885-86.
(3) Dujardin Beaumetz. *A Lecture on Aerotherapy. Therapeutic Gazette, May* 15, 1888.
(4) Von Vivenot. *Zur Kenntniss der physiologischen Wirkungen und der therapeutischen Anwendung der verdichteten Luft. Erlangen,* 1868.
(5) Paul Bert. *La Pression Barométrique. Paris,* 1878.

CHAPTER V.

OERTEL'S METHOD OF THE TREATMENT OF CHRONIC CARDIAC DISEASE.

PROFESSOR OERTEL, of Munich, has introduced a combined method of diet and exercise for the treatment of cases of cardiac disease. It is but little practised or discussed in this country, although something like it was recommended by Stokes; but it has given rise to much controversy abroad. Oertel first used it for a patient suffering from a fatty heart combined with obesity, and his earlier cases were chiefly of this nature, but the treatment has since been employed for valvular disease. It is often known as the Oertelischen-Kur, but it is perhaps more frequently called the Schweninger-Kur, deriving this name from a well-known German physician, who much employs it. The original patient, one of Oertel's, was a man who had deformity of the spinal column, secondary to fractured spine, and the consequent diminution of the thoracic capacity hampered both circulation and respiration. When he was passing from boyhood to manhood he drank considerably more fluid than previously, as he took abundantly of wine and beer; he became obese, and suffered from all the symptoms of a fatty heart; and, although formerly, in spite of the thoracic deformity, he was able to take plenty of exercise, very slight exertion now produced palpitation and breathlessness.

The problems which Oertel set himself were, firstly, by a diminution of the quantity of fluid in the body to lessen the work of the heart and the congestion of the organs; secondly, to reduce the fat throughout the body; thirdly, to increase the strength of the muscular fibre of the heart.

With regard to the first problem, he considers that the blood in these cases contains too much water in proportion to its solid constituents, and to this condition he applies the term serous plethora, which he endeavours to remedy by diminishing the supply of water, and at the same time increasing its excretion. Bleeding would diminish the quantity of the blood, but not only does it take away from the body valuable solid constituents, but it is for many reasons contra-indicated. Diuretics are uncertain, and throw extra work on the kidneys, which are already congested. Diaphoretics cause much thirst, and have most of them some important disadvantage. Therefore Oertel thinks that the best way of coping with the problem is to diminish the supply of water drunk, and to aid its excretion by the sweating induced by Turkish baths and exercise. Experiments were made upon the patient just mentioned when he was sufficiently improved to be a fit subject for investigation, and they showed that mountain climbing greatly increased the excretion of water by the skin and lungs, even although but little fluid was supplied as drink, and a small quantity, almost equal to it, was excreted in the urine. For example, a mountain ascent of 1,100 feet, lasting 3¾ hours, diminished the body weight by very nearly 2½ lbs., of which about 2 lbs. were lost in the excretion by the skin and lungs. After due allowance for the food taken, this represents six times as great a loss of weight by the skin and lungs as would have taken place had the patient sat still all the time. Many other experiments gave more or less similar results. These observations were made when the patient was considerably better, and could walk up the mountain with comparative ease, but he said that the perspiration was much more profuse when he was so bad that he had to stop every few steps during the ascent. The loss of weight is always found to be much more rapid during a quick ascent than during a prolonged one, and the external temperature did not seem to exert anything like so great an influence as did the work performed.

It is both unsatisfactory and difficult to make any comparison between things so different as the various modes of producing diaphoresis, but after many experiments, Oertel came to the conclusion that mountain climbing is by far the most powerful means of increasing the excretion of water by the skin and lungs, and that the next most potent but more uncertain method is the subcutaneous injection of pilocarpin, then a Turkish bath, and last of all in its efficacy comes a vapour bath. Taking all things together we may therefore conclude that the copious secretion of perspiration which follows mountain climbing is the best means we possess of causing an increased excretion of the fluids in the body, especially if at the same time the patient drink but little.

The second part of the problem, or how to reduce the adipose tissue in cases of fatty heart and general obesity, divides itself into two parts, the dietetic and mechanical.

In his consideration of the first, Oertel takes as a basis certain well-known physiological facts, and from them deduces what he considers to be a suitable diet. I have omitted many of his subsidiary conclusions because they are irrelevant, and also because they would not be admitted by physiologists as correct. It is known, from physiological experiments, that fat can be produced by either a nitrogenous, a fatty, or a carbohydrate diet. If too little fatty or carbohydrate food be taken, fat will be given up from the body, but if more fat or carbohydrate food be given than is required, the greater part of the excess is stored up. It has been firmly established that a proteid diet increases both proteid and fatty metabolism. Now the metabolism of proteids means the storing up of fats from them, but it has been shown by many experiments that proteid metabolism is restrained if there be fat in the body or the food, and in this respect carbohydrates play the same part as fat. So that, as might be suspected, the effect of an albuminous diet is different in lean and fat people. In the former, as there is nothing to protect the proteid metabolism, the ingestion of large quantities of proteid food leads to a considerable proteid metabolism, and a consequent accumulation of fat; but if the person be already fat the proteid metabolism is restrained, and, consequently, little or no fat is stored up from it, but, inasmuch as a proteid diet is a powerful excitant not only of proteid metabolism but also of fatty metabolism, the feeder becomes thinner.

Any diet having for its object the reduction of fat in the body should contain a large amount of albumen, and therefore anything which can impair its digestion must be avoided; hence diluents such as fluids at meal times should, according to most authorities, be forbidden.

From the above considerations it is clear that the diet must be highly nitrogenous, but not exclusively so, for, firstly, much dyspepsia would be induced; secondly, if not enough fats and carbohydrates were given the destruction of albumen in the body might possibly be increased, and fat might be stored up from this, but, considering that the fat present in the body of the patient would most likely be quite sufficient to protect the metabolism of the proteids, the advantage of giving fats or carbohydrates is more probably correctly to be ascribed to the prevention of indigestion and nausea. The diet then should consist of a large amount of albumen with some fats or carbohydrates, and but little fluid. One part of fat is on the average isodynamic with 2·4 parts of carbohydrates: we are, therefore, much less likely to give too much if we use them rather than fats. To meet these requirements, Oertel gives in his work the following diets :—

DIET I.

Fluids.						Solids.					
	Quantity in grammes.	Water.	Albumen.	Fat.	Carbo-hydrates.		Quantity in grammes.	Water.	Albumen.	Fat.	Carbo-hydrates.
Morning—											
Coffee .	120	113·6	·21	·62	1.7	Fine Wheat					
Milk . .	30	26·2	1·29	·96	1·2	Bread . . .	35	12·4	2·4	·2	19·6
Sugar .	5	·1	·02	—	4·8						
						Midday—					
Afternoon—						Thin Roast					
Coffee .	100	94·7	·18	·52	1·4	Beef . .	200	116·0	76·4	3·4	—
Milk . .	25	21·8	1·05	·8	1·0	Salad . .	25	23·5	·3	1·0	·5
Sugar .	5	·1	·02	—	4·8	Bread . .	25	7·0	2·4	·2	15
Water .	50	50	—	—	—	Fruit . .	100	85·0	3·0	—	15
Evening—						Evening—					
Wine .	187·5	161·2	—	—	5·6	Two Eggs	90	66·2	11·2	10·8	·4
Water .	50·0	50·0	—	—	—	Roast Meat	150	87·0	57·3	2·6	—
						Salad . .	25	23·5	·3	1·0	·5
Total . .	572·5	517·7	2·77	2·9	20·5		650	420·6	153·3	19·2	51·0

Total quantity in 24 hours, in grammes :—

Water	938·3
Albumen	156·0
Fat	22·1
Carbohydrates	71·5

This is equivalent to about two pints of water, of which about 4/11 was contained in the solid food, leaving over a pint to be taken as fluid. The solids amount to about 1/3 lb. of albumen, 3/4 of an ounce of fat, and 2 4/5 ounces of carbohydrates.

Another diet is referred to by Oertel, in which rather more fluid is allowed by a little wine being given at midday, and rather more also in the evening. As variations, sometimes a little butter is permitted in the morning, a small piece of fish or boiled beef in the middle of the day, when also pastry or pudding in small quantity is occasionally allowed. Fowl may be given instead of roast meat in the evening, and very small quantities of caviare, sardines, smoked salmon, fruit, or bread and cheese are from time to time included in the diet, but only to give occasional variety. The principles that are evident in the table just quoted are to be the guide. In the second diet the fluid drunk is 730 grammes, the albumen taken in is 170, the fat 43·5, and the carbohydrates 114·0.

Mechanical means as aids to the diminution of fat are by no means unimportant. The destruction of fat is considerably increased by work, and although this is not true of albumen, nevertheless, inasmuch as work leads to muscular hypertrophy, the need for albumen, and consequently the proteid required, must be somewhat increased in a body doing much work; hence for two reasons it is very important that muscular work should, as far as the conditions of the case will permit, be performed. This is true of obesity, but even more true of cases of fatty heart, for in them the organ is so weak and feeble that mere dietetic treatment with the object of leading to a reduction of the fat in the heart is of no use unless it be combined with some method of strengthening it. Its work must, Oertel says, be diminished by decreasing the intake of fluid, and increasing the watery excretion by the skin and the lungs, and it must be strengthened like any other muscle by gradually increasing the force and frequency of its contractions; these aims, he believes, are best fulfilled by muscular exercise, especially by climbing hills, which also powerfully aids the decrease of fat in the body generally.

Lastly, Oertel considers the third part of his problem, namely, the best method of directly aiding the circulation, and increasing the force of the heart. Braune has shown that the arrangement of the great veins with regard to the fasciæ is, in many parts of the body, such that movements of the limbs greatly help the venous flow. Also we know muscular movements to have the same effect, and therefore, as Oertel's experiments show, climbing, especially with an alpenstock, bringing into play as it does all four extremities, will powerfully assist the flow in the veins, and by increasing the respiratory movements still further accelerate the current of blood to the right side of the heart; and, moreover, owing to the greater expansion of the lungs, more blood is made to pass from the right side of the heart to them. Not only does climbing in these ways help the circulation, but as we have just seen, it does more, inasmuch as it increases the force and frequency of the heart's action, and thus leads to a hypertrophy of the normal cardiac muscular fibre, just as within certain limits intense action of any other muscle in the body causes its hypertrophy. Thus Oertel concludes that mountain climbing is a most potent agent in solving each of the three parts of our problem.

To recapitulate: Oertel's system of treatment for cases of corpulency with fatty heart and venous stasis consists in inducing by mountain climbing a considerable loss of water through increased excretion from the skin and lungs, a more forcible venous and arterial flow, and stronger cardiac contractions. The quantity of fluid which the patient is allowed to drink is much lessened, and the obesity is combated by a diet consisting chiefly of proteids, a little carbohydrate matter, and a very little fat.

This method is also used for cases of valvular disease of the heart in which there is no obesity, and, consequently, the strictly dietetic part is not required. With such patients the treatment consists in a diminution of the fluids drunk, and exercise; the object of the latter being to produce sweating, and a greater strength of the heart's contractions. One need hardly say that the exercise must be carried out with great judgment, care, and by gentle gradations. Oertel quotes some very instructive cases, one of which, for example, shows that, when 2,970 ccm. of water are taken in daily, the amount of urine secreted is but 1,460 ccm., showing a deficiency over the fluid drunk of 1,510 ccm., but when 750 ccm. of fluid only are drunk, 1,310 ccm. of urine are excreted, showing an excess of the urine over the fluid taken in of 560 ccm. These experiments were made on a patient with valvular disease of the heart.

As might have been expected, Oertel's method has been subjected to many criticisms; to some of these he has replied at length in a pamphlet referred to at the end of this chapter. Bamberger, who is one of his critics, first of all alludes to the beneficial results that undoubtedly often follow the treatment of chronic disease of the heart by Oertel's method, but goes on to point out that scrupulous care must be exercised in the selection of cases, for there is great difficulty in diagnosing the severity of the lesion, and this system can do much harm to those unsuitable for it. Lichtheim, Bamberger, and others criticise very severely Oertel's statement that the blood is more watery in these cases, for they urge that when a patient with much backward pressure is bled from his veins, the blood so far from being dilute is thick, and many observations have been made which show that the quantity of hæmoglobin and white corpuscles is actually greater in some instances of severe backward pressure, than in the healthy state; and further, some of the examples given in Bamberger's tables prove that while the œdema was increasing the blood was getting thicker, for the proportion of hæmoglobin and corpuscles to the plasma rose; in fact he is inclined to lay it down as a rule for cases of valvular disease, that the greater the œdema the thicker the blood; whether or not this is equally true for those of fatty heart he is not sure, but thinks that probably it is. This, it will be observed, is directly contrary to Oertel's supposition of serous plethora. With regard to exercise, Bamberger believes that, if the cases be properly chosen, a moderate amount, such as may be obtained by walking along level ground, is good for certain patients with valvular disease.

At the meeting of the Medical Congress at Wiesbaden in April, 1888, Oertel admitted that further experience had taught him that the method should not be used for atheroma, or grave incompetence of the cardiac muscle, nor should it be persevered in when the dyspnœa is increased by it, or the urinary flow excessively diminished.

In America it has been advocated by Barkan and Setlesen (quoted in Vol. V. of the *Annual of the Universal Medical Sciences*, 1888). Both these authors are of opinion that in appropriate cases much benefit is to be derived from mountain climbing. In America the Adirondacks and White Mountains are some of the best places, because they have good roads and paths.

It will have struck the reader that the only new part of Oertel's system is the mountain climbing. People suffering from obesity have often been treated by a diet mainly proteid, and also have been accustomed to take Turkish baths, with the object of increasing the perspiration. Whether his new method of treating fatty heart and valvular disease by exercise, especially mountain climbing, ultimately stands or falls, must rest upon clinical experience, for there can be no doubt but that some of Oertel's physiological deductions are erroneous, and that he is also mistaken in his conception of some of the pathological conditions present in these patients. If ultimately it is allowed, as probably it will be, that the system is beneficial in some cases, it will be an example, not by any means without its parallel in medicine, of a good method of treatment having been discovered, in spite of the fact that some of the data which were used for deducing it were incorrect.

When it first came into vogue some of the patients who tried it were unsuitable. We may certainly say that all those who are made worse by it, however temporarily, whether by increased dyspnœa, or in any other way, those who have an aneurism, those with much atheroma, those with aortic regurgitation, and those with extreme degeneration of the cardiac muscle, had better avoid anything but the very gentlest exercise.

On the other hand many patients with cardiac disease are doomed by their doctor to a quiet sedentary life, although they would be much better if they took a moderate amount of exercise. The other day I came across a man with valvular disease, who for five years tried, at the advice of his physician, leading a quiet life, undergoing but little or no exertion, but his symptoms remained stationary. He was then recommended by a continental physician to take to mountain climbing in moderation. He did so, and the result was that he improved in every particular.

In the selection of cases for treatment by muscular exertion, it must be interdicted for those just mentioned, and if it be decided to try it for fatty heart or valvular disease, each case must be judged upon its own merits. The exercise must be at first slight, and if it do no harm, it can be increased daily by small gradations. The physician should see the patient frequently, especially immediately after the walk, and whether walking be forbidden, or more be advised, will depend upon the effects produced by it. No sudden exertion must be allowed: the exercise must be uniform and not too severe: running, jumping, rowing, cricket and football are out of the question: in fact scarcely anything is permissible except walking, either upon level, or ascending ground.

The chief indication for the production of sweating is probably the œdema, for it is certain that it can be reduced by this means.

For further information consult :—

(1) Oertel. *Therapeutics of Circulatory Derangements. Von Ziemssen's Handbook of General Therapeutics. English Trans., London*, 1885-86.
(2) Oertel. *Zusätze und Erläuterungen zur allgemeinen Therapie der Kreislaufs—Störungen. Leipzig*, 1886.
(3) Bamberger. *Ueber die Anwendbarkeit der Oertel'schen Heilmethode bei Klappenfehlern des Herzens. Wiener Klinische Wochenschrift*, No. 1, 1888.

CHAPTER VI.

DIET.

All foods contain proteids, fats, carbohydrates, salts and water in varying proportions. Everybody consumes daily some of each of these. It will be well therefore if we begin this chapter with a brief summary of our physiological knowledge of these groups.

Proteids.—We know that the proteids in the food are rendered capable of absorption, chiefly by their conversion in the stomach into peptones, and to a slight extent perhaps by the formation of leucin and tyrosin from them by the pancreatic juice. It is however by no means certain that all the proteids are converted into peptones, and some experiments show that possibly it is not beneficial that all should undergo conversion. The peptones most probably undergo some further alteration during absorption, but ultimately the proteid material of the food, in some form or another, reaches the blood. We do not understand its changes in the body, but sooner or later by a process which is mainly one of oxidation, it becomes converted into urea. It is generally thought that this metabolism goes on partly in the tissues and partly in the circulating fluids, such as the lymph bathing the tissues, and the blood. More nitrogenous material is believed to be metabolized in the circulating fluids than in the tissues. To this view the following experiment lends support. If an animal be starved, the urea excreted during the first few days of the period of starvation is proportionate to the amount of albuminous food previously taken, but afterwards its excretion falls very low. This is explained if we suppose that at first the excretion of urea is due to the metabolism of such proteids in the circulating fluids as are derived from the albuminous food taken before the starvation began, but that after a time these are all used up, and the proteids of the tissues are called upon and render up from their metabolism the small amount of urea excreted.

In fever the amount of urea excreted is greater than would be got rid of by a person in health and taking the same diet; although the healthy man is able to digest his food better than the fever patient in whom the secretions are arrested. This increase is, in great part at least, due to increased nitrogenous metabolism in the tissues themselves, as is shown by the great wasting of the muscles so common in fever patients.

It is of great dietetic importance that we should consider some of the circumstances which influence the rapidity of nitrogenous metabolism in the body. If the quantity of proteid food is increased till at last nothing but proteid is taken, the excretion of urea increases in a more rapid proportion, until the nitrogen excreted in the urine equals that ingested in the food. This condition is called one of nitrogenous equilibrium. We learn from this experiment that the ingestion of nitrogenous food largely increases the nitrogenous metabolism of the body. During the condition of nitrogenous equilibrium the animal gains considerably in weight: therefore it is concluded that the ingested proteid is split up into a fatty and a urea moiety, and that the former is stored up and the latter excreted. It is quite possible that this may take place to a less extent before nitrogenous equilibrium is reached, and that fats are in this manner derived from a proteid diet. But on the other hand proteid food increases not only the proteid, but also the fatty metabolism: therefore an increase of the proteid in the food may, if much fat be present in the body, lead to a loss of weight, for the loss due to the fatty metabolism is not compensated for by the increase of the fat which is derived from the increased proteid metabolism. This is well seen in the effect of proteid food in reducing obesity.

Another point of importance in medicine is that proteid metabolism is influenced by the previous condition of the patient; for example an amount of proteid which in an emaciated convalescent patient would induce an increase of weight, would lead to a loss of weight in a healthy man.

It is well known that both fats and carbohydrates have the power of checking nitrogenous metabolism. The value of this will be evident in the next chapter.

It is a fact beyond all doubt that muscular exercise does not increase the excretion of urea, and Fick and Wislicenus have shown that the energy derivable from proteid metabolism is quite insufficient to account for the amount of muscular work they performed during the ascent of the Faulhorn: therefore we must conclude that muscular motor work is derived from non-nitrogenous metabolism going on in the muscle. Probably the nitrogenous metabolism has to do with the thermogenetic function of the muscle; if this is so it will explain how it is that the excretion of urea is increased during fever, and also why it is so constant during health.

Flesh, which only contains albumen, water, and salts, is the single food which can support life, for any length of time, for, as we have seen, fat can be formed from albumen, but it is not a suitable diet, because of the excess of proteid necessarily ingested, and because of the loathing and indigestion it induces.

If an animal be fed upon peptones for months together, to the entire exclusion of all other nitrogenous food, it does as well as if it took ordinary proteids, and there is considerable clinical evidence that, in those cases in which proteids cannot be taken, artificially digested albumens formed into peptones may be substituted with good effect. Care must be exercised to use some really efficacious peptonizing substance, for there are a great many in the market which are fraudulent. They are mostly proprietary articles, and directions for their use are sold with them. They may be used with any article of food the physician may desire. Milk is frequently peptonized. It is prepared by diluting a pint of milk with a quarter of a pint of water, heating to 140° F., adding two drachms of Benger's *Liquor Pancreaticus*, and twenty grains of bicarbonate of soda. The mixture in the ordinary temperature of a room must stand three hours. It should then be for a moment raised to boiling point. The extremely disagreeable taste of most of these artificially digested foods may be, to some extent, overcome by stopping the process of digestion before it is quite complete.

The majority of the peptonizing preparations are derived from the pancreas, and are in the form of a white powder called pancreatin: some are fluid, as Benger's *Liquor Pancreaticus*. Sir Wm. Roberts advises the following test to determine their potency. The powder or liquid, when added to fresh milk without an alkali, confers on it the property of curdling upon boiling, and the value of the preparation is estimated by the number of cubic centimetres of milk which at a temperature of 114° F. one cubic centimetre of the preparation can in five minutes curdle on boiling. The number for Benger's *Liquor Pancreaticus* is between fifty and seventy. Wood gives the following test. Five grains of powdered pancreatin added to twenty grains of bicarbonate of sodium should so alter in an hour the caseine contained in one pint of milk at a temperature of 115° F., that no coagulation will occur on the addition of nitric acid.

Gelatine like non-nitrogenous food renders nitrogenous equilibrium possible with a less ingestion of proteid than a proteid diet alone. It diminishes fatty as well as proteid metabolism. It is probably split up into urea and fat, but has no power of supplying the place of proteids in the food.

Fats.—The digestion of fats which is in man carried on by the gastric juice is insignificant. They are nearly all converted into an emulsion, and to a small extent saponified by the combined action of the bile and pancreatic juice. The emulsified fats are taken up by the lacteals. That bile does digest fats is shown by those cases in which there is some obstruction to the entrance of bile into the intestine, for the fæces then contain a large amount of undigested fat.

If a person be taking an ordinary mixed diet on which his weight remains stationary, and then, all other circumstances being the same, he decreases the intake of fat, the whole of the fat he takes will be accounted for by the carbon of the egesta, and also a drain will be made upon the fat of the body, and, therefore, he will lose weight; on the other hand, if he increases the intake of fat all its carbon will not reappear in the egesta, and fat will be stored up. The weight of the body will be increased more than can be accounted for by the excess of fat in the food, for, as we have just seen, fat has the power of restricting proteid metabolism, and the body therefore gains in weight from this source as well as from the addition of fat to it from the outside. Fat stored up in the body has the property also of retarding proteid metabolism. This explains the fact that fat people are often small eaters. An increase in the amount of work performed or a rise of the temperature of the body leads to an increased metabolism of fat.

The fats of the body can be derived either from the fat in the food, from proteids, or carbohydrates. The fat in the food must undergo some change before it is stored up in the body for it has been found that in the same animal, the same sort of fat is stored up whatever may have been the kind of fat taken in the food.

Carbohydrates.—The starches are converted into sugar by the saliva and pancreatic juice, this sugar is absorbed together with that in the food. A large amount at least of the absorbed sugar is in the liver converted into glycogen, where it is stored up, for what purpose however is doubtful, for according to some it will, as the demands of the organism require it, be converted into fat, but according to other observers the liver is a storehouse not for the formation of fat, but of sugar. We are not acquainted with the changes undergone by the sugar in the body, but there is strong evidence that fat can be formed directly from it; possibly it may be, as has been suggested, that the sugar undergoes butyric acid fermentation, and from this acid the higher members of the fatty acid series are constructed. There can however be no doubt of the fact that carbohydrates in the food lead to a storing up of fat in the body, and if the fat is not formed from the carbohydrates themselves, this storing up must be due to the property which they have of diminishing the completeness of proteid metabolism, for in that case the fat formed from the proteid metabolism would suffer no further change and could be stored up. Whatever may ultimately turn out to be the truth, two facts are certain, viz., an increase of carbohydrates in the food leads to an increase of fat in the body, and carbohydrates, like fat, have the power of diminishing proteid metabolism. It follows that, provided other circumstances are the same, if the supply of carbohydrates is diminished the body weight will decrease, for fat will cease to be stored up, the reserve of fat will be called upon, and proteid metabolism will be increased.

Animals fed on fats and carbohydrates entirely soon die, even if they are combined with gelatine.

Salts.—These are absolutely necessary for the maintenance of the body in health, but why this is so is not known. J. Forster has shown that animals certainly die if salts are withheld. The symptoms are that they become weak and prostrate, this weakness grows till it ends in death, but the animals do not lose flesh. Before the French Revolution the severity of the salt tax prevented many poor people in France from getting salt to eat with their food. They suffered from great anæmia, and weakness, which were set down to the want of salt.

Water.—This is necessary to life; all that need be said about it is to be found in Chapter VIII.

Diet in Health.—Individuals vary so much in their powers of eating that it is found impossible to give universal rules. As Professor Foster puts it, we can only speak of a normal diet in the same way as we speak of the average intelligence of man. According to Moleschott the dry food daily required for an ordinary working man of average height and weight is:—

Albuminous matter	4·587	oz.
Fatty "	2·964	
Carbohydrates	14·250	
Salts	1·058	

By reference to the table showing the composition of foods (p. 73), the various mixtures by which the above can be attained will be seen. From two to three pints of fluid are generally drunk in addition to the solids eaten, but as the solids contain much water, the actual amount of water taken is considerably in excess of two or three pints. The diet must not be monotonous, the food should be well cooked, and palatable. A slovenly meal will often disgust and render its enjoyment impossible. The food should be well masticated and eaten slowly. A rest after a meal, and before also, if the patient be very tired, is desirable. I have seen indigestion of many years' standing, in a man who walked home four miles after a hard day's work and ate his dinner directly on arrival, cured by his riding home and resting a little before his meal. Fluids are probably best drunk towards the end of a meal; an exception is made in favour of soup, for that stimulates the secretion of the gastric juice. All articles that are either very hot or very cold should be avoided. Meals ought to be at regular intervals, the chief of them when the body and mind have most chance of rest. Long intervals without food are always undesirable. Little and often is the best rule, if it be applied in moderation. It must be remembered that tastes and powers of digestion differ much. Many of these directions are vague generalities, but in a text-book this is unavoidable, for hardly any two cases of indigestion are precisely alike, and the skill of the physician is shown by his recognizing that one particular patient who comes before him can be cured by having small quantities of food five times a day instead of two large meals, another by resting before dining, another by taking longer over each meal, and another by some other slight alteration.

The following table shows the percentage composition of some of the more usual foods :—

Name.	Water.	Nitrogen.	Carbohydrates.		Fat.	Salts.
			Starch.	Sugar.		
Roast Meat	54	27			15·5	3
Bacon	15	8·8			73·3	3
Chicken	70	23			3	3
White Fish	78	18			3	1
Oysters	80	14			1·5	2·5
Eggs	74	14			10·5	1·5
Milk	87	4		5·2	4	·8
Cream	66	2·7		2·8	26·7	1·8
Skimmed Milk	88	4		5·4	1·8	·8
Condensed Milk	25	18		42	10	5
Cheese	36·8	33·5			24·3	5·4
			Nearly all Starch			
Fine Flour	15	9	74		1	·5
Bread	37	8	51		1·5	2·3
Oatmeal	15	12·5	64		5·5	3
Rice	13	6·5	79·5		·7	·5
Haricots, dried Peas and Lentils	10	25	57		2·5	2·5
Potato	75·7	1·7	20·5		·15	1
Turnip	91	1·2	5·1	2·1		·5
Green Vegetables	90	2·5		1·4	·7	1
Grapes	78	·6		24·5		·5
Average fairly correct for most other fruits	83	·6		5		·6

The figures in this table are sufficiently approximate for dietetic purposes. When, if added together, they do not make 100, it is because substances which do not fall under any of the columns given have been omitted. Much fuller information will be found in Dr. Pavy's work, from which the above list is mainly derived.

It is however of little use to be acquainted with the composition of the various articles of food unless we know how far they can be digested and utilized. There is a great waste of nutriment in vegetable foods, because they excite peristalsis and consequent rapid evacuation, and also because the membranes of the cells in which the nutritious matter is stored up are difficult of digestion. Rubner has made a number of experiments which show that flesh and eggs are utilized to a large extent, for only about five per cent. of the dry matter in them is excreted in the fæces: milk is not quite so good in this respect, but J. Forster has proved that it is better utilized in the infant than in the adult. About five per cent. of white bread is not used by the body, but with the coarser kinds the quantity is much larger, being fifteen per cent. in the case of black bread. The utilization of vegetables depends much upon the cooking; the assimilation of potatoes, carrots and cabbages is very defective, but rice and maize are well assimilated. Unless exceptionally large quantities of fat are taken it is very well utilized, and of the fatty foods butter is the best. Caution must be exercised in applying these facts about diets consisting of one food only, to the ordinary complex meals of mankind.

Digestibility of the Various Foods.—Animal foods consist of flesh, milk, cream, butter, cheese, eggs, and various parts of animals as bones, brains, liver, pancreas, kidneys, &c., &c. Flesh, that is to say muscle, varies in its digestibility. That of young animals is more tender than that of older, but is not so digestible, whilst that of very old animals is neither digestible nor tender. The best beef is from oxen, aged from four to six years, and the best mutton from sheep of from two to four years old. Veal and lamb are both of them less digestible than beef and mutton. The flesh of the female is generally more suitable for food than that of the male, which during the breeding season is almost uneatable, being very coarse and having a disagreeable flavour; castration much improves it. Lamb is in season in the spring, pork is out of season during the summer months. Buck venison is in season from June to September, and doe venison during the winter. Violent muscular exercise shortly before death makes the flesh tender: this is the cause of the tenderness of certain kinds of hunted game. Meat is much more easy of digestion if it be allowed to hang until rigor mortis has passed off. Mutton is the most digestible flesh of mammals, beef is not quite so good in this respect, and pork is the most indigestible, ham and bacon are much more digestible than pork, especially the lean part of ham, with which some persons of weak digestion do not find any difficulty. Venison, hare, and rabbit are fairly digestible if so cooked as not to be too rich. The liver, the kidney, and the heart are all indigestible. Tripe, and sweetbread, which is sometimes the thymus, when it is called throat sweetbread or calf's fry, and sometimes the pancreas when it is called stomach sweetbread, are easily digested if plainly cooked; some people find this true also of brains, which however contain much fat.

The flesh of birds is much more digestible than that of mammals, a young chicken is, except a few fish, the best form of meat, and if ducks, geese, and with some persons turkey, be excluded, all birds that are eaten as food are easily digested; the breast and wings always being preferable to the legs.

Among fish the whiting comes first and the sole next, they are both of them more easily digested than any other form of meat. Fish, the flesh of which is red, is indigestible compared to that with white flesh. The herring, eel, mackerel, and the under part of the salmon, are the fattest of such fish as are used for food.

Among invertebrate animals the oyster is the most digestible, and can be tolerated by many dyspeptics. It should be eaten raw, as cooking coagulates it; the liver is the most digestible part, and therefore some people prefer not to eat the adductor muscle which forms a large portion of the animal. During the summer months they are out of season. The lobster is indigestible, the flesh from the claws is less so than the other edible parts of the animal. Crabs, crayfish, prawns, shrimps, winkles, mussels, and all animals popularly called shell-fish are, except the oyster, to be avoided by most persons.

Eggs, if eaten raw or but lightly boiled, are very easily digested, but the reverse is true if they are hard boiled.

The closer kinds of cheese, such as Dutch cheese, although containing much nutritious matter, are very indigestible, however eaten, but most of all when toasted in any way. A small piece of well-matured good cheese, as Stilton, can generally be taken without discomfort.

Good bread is easily digested, that made from the whole of the grain, so that the outer coarse covering is included, is, because of its slightly irritating effect on the intestine, very useful to people who suffer from habitual constipation, but it may cause diarrhœa in others. New bread is difficult of mastication, and therefore indigestible. Dry crisp toast, pulled bread, rusks, and tops and bottoms which contain flour, butter, milk, and sugar are very digestible, because they must be well broken up by the teeth before they are swallowed. Hot buttered toast, muffins and crumpets, like all food soaked in fat, and suet puddings, heavy pastry, and all other articles of diet of a close consistency, are very indigestible. Plain biscuits, which differ from bread in being dried, can be taken by almost any dyspeptic, and in the form of biscuit powder are much used with milk for invalids. Macaroni and vermicelli come under the heading of foods of a close consistency, but semolina is easily digested. Oatmeal is highly nutritious and digestible. Rye bread is disagreeable to the taste, and liable to cause diarrhœa. The foods prepared from maize, such as hominy and oswego, contain about the same amount of nitrogen as wheat, and a large proportion of fat; they are thus of great value, especially as they are not difficult of digestion. In this respect rice agrees with them; it, however, contains but little nitrogen and a quantity of starch. It is best cooked by steaming.

Leguminous seeds, on account of the large amount of nitrogen they contain, are very nutritious, but not easy to digest, and should therefore always be boiled for a long while. Those most used are broad beans, haricot beans, French beans, scarlet runners, peas, and lentils.

Potatoes should be steamed, or cooked in their skins, in order to prevent any loss of nutritious substances; when mealy they are easy of digestion, but when close, like Jerusalem artichokes, turnips, carrots, beet-root, and radishes, they are very indigestible.

Many herbaceous plants are used as food: the most digestible are those which are cooked and eaten when young, such as asparagus, cauliflower, and sea kale; whilst those which are eaten raw, as, for example, celery, lettuce, endive, and mustard and cress, tax somewhat more the powers of digestion. Spinach and cabbage occupy an intermediate position. These substances are not very nutritious, for they contain about ninety per cent. of water. Tomatoes and vegetable marrows are digested with ease, but cucumber and mushrooms are not.

There are so many fruits that it is impossible to speak of each individually, but as a rule to be capable of easy digestion, they must be soft either naturally or as a result of cooking.

Sago, tapioca, and arrowroot when cooked are readily digested, even by those whose digestive powers are feeble.

Idiosyncrasies.—There are people who cannot tolerate food which is quite natural to others, just as one meets with patients who are seriously affected by doses of drugs that would be quite innocuous to most people.

Mutton.—Dr. Prout in his book *On the Treatment and Nature of Stomach and Urinary Diseases* gives an account of a person who could not eat mutton in any form; however it was disguised it always produced attacks of vomiting and diarrhœa even if it was impossible to recognize during eating that the dish contained mutton.

Shell Fish.—If a number of people have partaken at the same time of the same variety of shell fish, one person will sometimes suffer from symptoms of shell fish poisoning, and he is always so affected when he partakes of the same variety of fish. These symptoms are therefore clearly due to some idiosyncrasy on his part.

Eggs.—It is well known that there are many persons in whom symptoms of severe indigestion are induced by taking eggs, and this happens even if they are so skilfully blended in a made dish that it is quite impossible to recognize them either by taste or sight. Dr. Lauder Brunton, for example, gives an account of a lady who was always seriously affected by eggs. On one occasion she took a small piece of cake because she was assured it did not contain any eggs, the result was that she had violent vomiting and purging; it was then found that a mistake had been made, for the cake contained eggs.

Milk.—Similar effects are sometimes caused by milk; I have known milk which was ordered for a patient with ordinary indigestion, produce symptoms of acute dyspepsia.

Strawberries.—Dr. Lauder Brunton (*Disorders of Digestion*) gives an account of a lady in whom a single strawberry gave rise to much erythema of the face.

Oranges.—I know a gentleman who always breaks out in a profuse perspiration and his face becomes very red whenever he eats an orange.

Mushrooms.—Dr. Pavy states that some people cannot eat them without serious derangement of the stomach.

Apples.—Sometimes however small a portion of an apple be taken it produces severe indigestion.

The effects of tea, coffee, alcohol and tobacco, as is well known, vary very much in different individuals.

Foods may do harm apart from any idiosyncrasies. Thus both fish and shell fish, especially mussels, are at times poisonous; those who have partaken of them are attacked with vomiting, diarrhœa, fever, and an erythematous eruption. Tinned meats and fruits, sausages, cheese, fruits, especially if turning bad, and decomposing meat, are all liable to cause toxic symptoms. Under certain conditions almost any article of food can become a sufficiently powerful poison to affect all who take any of it. Various parasites, as tape worms, hydatid, &c., may gain an entrance to the body with the food, and scarlet and typhoid fevers may be transmitted by milk.

Tea.—About tea, coffee, and alcohol there exists much illogical fanaticism. It must always be borne in mind that whilst some persons can with impunity take a moderate amount of them, the same quantity will in others produce symptoms of poisoning; no general rule can therefore possibly be laid down. Usually however, those who are injuriously affected make the sweeping assertion that these substances are harmful for all people.

With regard to tea the following facts are certain. It is often extremely refreshing, it enables those who drink it to work when tired, and it appeases the appetite; on the other hand, it may produce indigestion, and if taken near bed time frequently prevents sleep. Some varieties contain much tannin. As there is considerable doubt as to the quantity of this ingredient extracted from tea by a short and a long infusion, and also as to the percentage of tannin in different teas, I have had three samples carefully analyzed, with the following results :—

Name.	Percentage of tannin by weight extracted by infusion for three minutes.	Percentage of tannin by weight extracted by infusion for fifteen minutes.
Finest China ...	7·77	7·97
Finest Assam ...	11·30	17·73
Common Congou	9.37	11·15

All the above were unblended, and no green tea was used. The dyspepsia that tea causes is often set down to the tannin, and these analyses support this conclusion, for dyspeptics who cannot take ordinary tea often find no bad symptoms are produced if they restrict themselves to the finest China, the only objection to which is its high price; and many in whom the indigestion tea causes is less marked find that it can be avoided altogether, even with the ordinary varieties, if the infusion drunk is poured off from the leaves in three or four minutes. Such tea is also more refreshing than that which has been infused a long while. Tannin is particularly injurious to the digestion of fresh meat. It is said not to interfere with that of dried meat, and this is, as Dr. Lauder Brunton says, probably the reason why tea is not commonly harmful at breakfast, because fresh meat is not often taken at that meal. Some few authorities deny that the evil effects of tea upon the digestion are due to tannin, but the weight of evidence is against them. Often the harm wrought by it is owing to the fact that it is drunk whilst it is too hot.

If taken in large quantities, tea produces toxic effects. I have met with three such cases. The symptoms were a condition of extreme nervousness, and a trembling of the body, the arms and the tongue, which was much more violent under excitement. The arms were always the most affected, but in the worst case the trembling extended to the legs and was at times universal; there was paresis of the muscles even when they were not tremulous. Any unexpected incident, such as the sudden entrance of some one into the room, immediately caused a great increase of the trembling. In one patient the speech was confused. Two suffered from insomnia, the third did not. The indigestion was very severe, there was great loss of appetite and absolute loathing of food. With one of the patients this was so bad that she would go two or three days without any solid food, living only on the milk and sugar in her tea. Excessive tea drinking injures the teeth.

Tea is not a food, but a beverage; as a medicine it is diuretic, and relieves certain forms of headache.

Coffee contains less tannin but has much the same effect as tea. It is peculiar in its action on the intestines, for some persons find it constipating, and others secure a healthy action of the bowels in the morning by drinking a cup of *café au lait* at breakfast.

Alcohol is quite unnecessary in health, and therefore need not be treated of at any length in this chapter. In small quantities it stimulates the secretion of the gastric juice, and also the movements of the stomach, and therefore a little is useful for those whose powers of digestion are weak, particularly at the end of the day when they are especially low owing to the general exhaustion of the whole body. In large quantities it distinctly impairs digestion, and one of the most frequent causes of dyspepsia is over-indulgence in alcohol. If not too weak it reflexly stimulates the heart, and therefore if given to arouse a person from syncope it should be concentrated. After absorption it dilates the blood vessels, and as the heart is also stimulated the blood circulates easily, and thus temporarily there is a sensation of warmth, a pleasant glow, a feeling of exhilaration, and the faculties are quickened, but all this soon passes off. Owing to the dilatation of the cutaneous vessels the blood rapidly gets cooled, therefore alcohol is, as universal testimony proves, harmful during exposure to cold, although it may be beneficial afterwards when a return has been made to a warmer atmosphere, for then, by the dilatation of the vessels of the skin, the blood will be warmed. Experience too teaches us that the exhilaration and acuteness of the mental faculties is quickly succeeded by the opposite conditions, and it is certain that prolonged mental or bodily work can be done much better without alcohol. The susceptibilities of people to its influence vary immensely, in some even small doses produce headache and somnolence. As an article of diet it may be taken for a pleasant stimulating beverage to aid a weak digestion, and at bedtime to induce sleep, always provided that the quantity is small, that the patient can be trusted not to be guilty of excess, and that he is better for it.

Cooking.—If in cooking meat the object be to retain as much as possible of its nutritious substance, it should either be suddenly plunged into boiling water or put before a very hot fire for the first five minutes or quarter of an hour, for by this means there is formed on the surface a layer of coagulated albumen which prevents the loss of the juices of the meat; the cooking should then be finished in water at a temperature of about 170° F., or rather further from the fire. If it be required that the most valuable parts of the flesh should pass out into the fluid into which the meat is placed, as is the case with soups and broths, which are only weak soups, then it should be put into cold water which is subsequently heated to about 170° F., at which point it is maintained. To obtain the most nourishment from the meat, it is of course better that it should be chopped up finely. Soup and broth require a much longer time to make than beef tea, in order to extract the gelatine, an ingredient which gives to soups their property of coagulating.

In the process of skimming which is usually adopted for soups, broths, and beef tea, the fats and the slight amount of albumen which have been extracted are removed, so that soup consists of little more than gelatine and extractives, and beef tea contains only the extractives.

Broths are generally made from mutton, chicken, or veal. To prepare them the meat should be put into a saucepan of cold water, heated to nearly boiling (about 170° F.) and maintained at this temperature for two hours, and then strained. The excess of fat should be skimmed from it when it is cool. A very usual concentration is a pound of meat and so much water that when the boiling is finished it shall measure a pint.

The most digestible way of cooking meat is either by boiling or stewing. Roasting gives more flavour, and roast meat can be very well borne by all except bad dyspeptics. Meat that is baked is said to be a little less digestible than that which is roasted, and fried meat is the least digestible of all.

Vegetables are indigestible unless cooked. Steaming is the best method for potatoes, as by this means none of the constituents are dissolved out.

Beef Tea.—Dr. Pavy recommends that it should be prepared as follows: Mince finely one pound of lean beef and pour upon it in a preserve jar one pint of cold water. Stir, and allow the two to stand for an hour. Next place the preserve jar in a saucepan of water, and boil gently for an hour. Remove the jar and pour its contents on a strainer. The beef tea which runs through contains a quantity of fine sediment that is to be drunk with the liquid, which should be flavoured with salt. The jar may be put into the oven for an hour instead of into water. Any fat that may be seen floating on the surface of beef tea should be skimmed off, but if it has been properly prepared there should not be any.

Chicken, veal, or mutton tea may be made in the same way.

The various beef extracts that are sold, and beef and other meat teas contain but little actual nutriment, although they are on account of their extractives powerful stimulants both to digestion and the nutritive processes of the body. They contain only kreatin, kreatinin, sarcosin, xanthin, inosit, fat and salts, and it has been proved that animals fed upon them quickly starve to death. Mays (*Transactions of the College of Physicians of Philadelphia*, 1886) has shown that applied to the isolated frog's heart, which is becoming feeble, these extractives most markedly increase the strength and frequency of the beats. The preparations he experimented with were Reed & Carnick's Beef Peptonoids, Parke, Davis & Co.'s Sarco-peptones, Cibil's Extract of Beef, Valentine's Meat Juice, Johnson's Fluid Beef, and Liebig's Extract of Beef. They are placed in their order of potency as regards their effect on the frog's heart. He makes the valuable suggestion that they may be injected subcutaneously. I have used Valentine's Extract for this purpose. It produces no irritation or other evil effects.

Many attempts have been made to obtain preparations easy of digestion which shall contain the albumen of meat. An instance of such a preparation is the *succus carnis recenter expressus* which is obtained by pressure from raw meat according to the directions of Pettenkofer and Voit. It contains salts, extractives and about six per cent. of albumen. It can easily be prepared by subjecting pieces of lean beef to great pressure in a press. There are also many preparations which are intended to contain the proteids of meat predigested and therefore converted into peptones. In 1867 Dr. Pavy had some fluid meat of this description prepared by Messrs Darby & Gosden, of 140 Leadenhall Street. Bauer rightly considers that it is a serious objection to all preparations in which the proteids have been converted into peptones that they are extremely disagreeable to the taste, and, as has been already shown, it is possible that it is not desirable that the whole of the albumins should be peptonized. He gives the preference to Leube's Dissolved Meat which may be obtained in England of Messrs. H. Poths & Co., 4 Sugar Loaf Court, E.C. This preparation contains both peptones and albumins. The need for carbohydrates may be met by the addition of some milk, and the taste may be improved by adding a little extract of meat.

Of the numerous substances sold which profess to contain the albumins of meat predigested, the majority have little or no albumen or peptones in them. Considering the number of fraudulent preparations that have been put in the market, I would advise no one to place dependence upon any of them unless he knows from analyses conducted by persons having no interest in the preparation that it does contain a considerable amount of albumen.

A book such as this is not the place for further directions for cookery. *Light Diet*, by Dr. H. W. Seager, which has been recently published, gives in a concise and very cheap form every direction that can be required for the preparation of food for all kinds of invalids.

Enemata.—These are given either to cause an evacuation of the bowels, or to introduce nourishment when from any reason it is impossible to take it by the mouth.

A purgative enema should always be copious, a pint or even more.

A nutrient enema, if introduced no further than the rectum, should not contain more than four fluid ounces; a larger quantity however may be injected if the patient lie on his left side and a long tube is passed into the sigmoid flexure, and the fluid is thrown up gently, either with a syringe or by being poured through a raised funnel which is attached by some india-rubber tubing to the tube in the rectum. Nutrient enemata should not be repeated too often, or the rectum will become intolerant of them; every four hours is a usual frequency. After the administration of an enema it is well to press a towel for a few minutes against the perinæum to aid its retention. The rectum should be empty when the enema is given, and therefore if a natural motion has not been recently passed the bowel should be washed out with warm water. The temperature of the enema should be about 100° F.

It is clear that before deciding what to put into a nutrient enema it is of the greatest importance to know the capability of the rectum for absorption. Voit and Bauer have shown that the albumins present in expressed meat are absorbed by the rectal mucous membrane to nearly the same extent as complete peptones, but egg albumen is not unless chloride of sodium is added to it. Starch is certainly converted in the rectum into sugar, and as such quickly absorbed. The fate of the fat is doubtful. These results have been confirmed by others. Further experiments made chiefly by Leube showed that egg albumen and salt are quite unsuitable, as they are too irritating, and that peptones and the expressed juice of meat cannot be employed for long together. Leube found that the best enema, that is to say the one which is most nutritious, most readily absorbed, and least irritating, could be prepared as follows:—The meat is first sliced very thin, and the slices chopped as fine as possible; of this from five to ten ounces are taken together with from one to three ounces of finely chopped pancreas, free from fats, and to this mixture about a quarter of a pint of lukewarm water is added. If desired, from half to one ounce of fat may be mixed as intimately as possible with the help of a warm pestle and mortar; but this is not desirable, as the addition of fat renders an enema liable to be returned. Three or four ounces of this mixture may be injected each time through a syringe with a nozzle sufficiently wide to take it. Starch should not be added as it may cause nutrient enemeta to be rejected. An examination of the motions showed that these enemata were digested. The excretion of urea was increased and the patients said that the feeling of hunger was satisfied. I have used them for a woman who had a gastric ulcer due to swallowing hydrochloric acid. They were easily retained, and supported life for three or four weeks. She however wasted considerably, and complained of hunger, but not excessively.

It is said that the most carefully devised nutrient enemata cannot give more than a quarter of the nourishment that the body requires, but it is not stated whether this means a quarter of the nourishment required during rest in bed, or during ordinary life. After a time varying from a day or two to a few weeks, the rectum generally becomes intolerant of enemata. No rules can be given as to the length of time for which they can be borne, as so much depends upon the previous condition of the patient. Occasionally the retention is facilitated by the addition of a little opium, and sometimes an aperient enema given now and then will, by thoroughly clearing the rectum, aid the retention of nutrient enemata.

Milk, beef-tea, and the yolk of eggs are often made into nutrient enemata, and their digestion facilitated by the addition of two drachms of Benger's Liquor Pancreaticus. Brandy or drugs may be added as desired. Defibrinated ox-blood has also been used, but at present we have not sufficient evidence to decide upon its value.

Subcutaneous Injection.—Milk, yolk of eggs, and oil have been injected subcutaneously, but the quantity of nutriment that can be introduced this way is so small that the method is of no practical value.

Nutrient Suppositories.—There are many of these in the market. All the best-known manufacturing chemists prepare them. The basis of most is milk or pre-digested meat. It is certain that often they maintain life for a considerable time. The only objection to their use is that which holds for all ready made-up articles that have no officinal composition, namely—that we are entirely in the hands of the chemist who prepares them; and the physician may be unfortunate enough to select those which have not the properties they profess to possess.

Suppositories should always be oiled before introduction. Dr. Gadd (*Therapeutic Gazette*, 1887, p. 312) gives the following directions by which the physician can make them for himself. To a pound of raw, minced rump steak, add a pint of water, two fluid ounces of liquor pancreaticus, and a drachm of sodium carbonate. Keep the mixture at 120—140° F. for five hours, stir occasionally, and add water from time to time to compensate for evaporation. Then press the mixture through a fine muslin strainer, neutralize it with hydrochloric acid, and evaporate it slowly down to the consistence of an extract or even to dryness. He advises that the basis of the suppository should not be cacao-butter, as it is liable to turn rancid, but theobroma-oil, or a mixture made by soaking an ounce of pure gelatin in a fluid ounce of water, dissolving this in three and a half fluid ounces of glycerin by means of a water-bath, and then allowing the result to solidify. A hundred grains of the extract of beef mixed with sufficient basis will form ten suppositories.

Milk Cure.—This has been employed in albuminaria, severe dyspepsia, as the first step in cases of anorexia nervosa, and in gastric ulcer. I have seen a case of anorexia nervosa cured partly by this means, and have recently had two patients with obstinate dyspepsia who have been completely cured by milk-diet. One particularly intractable case was sent to bed for a fortnight, and had no food save a quarter of a pint of milk every day for the first few days, and afterwards a pint daily, but she was never allowed to take more than a tablespoonful at a time. The quantity of milk must, to begin with, be small, say a quarter of a pint four or five times a day or even much less, for it is only by giving small quantities at frequent intervals that the patient can tolerate it; gradually the quantity may be increased, but that ultimately attained will depend much upon the disease from which the patient is suffering; large amounts may be taken in cases of anorexia nervosa. If the taste be very repugnant the milk may be slightly flavoured with a trace of coffee. Contrary to one's expectation constipation does not often ensue, but if it should, a simple enema occasionally or a little castor oil will usually get over the difficulty.

Koumiss.—This is fermented mare's milk. In the process of fermentation carbonic acid gas, lactic acid, and alcohol are formed. It is a regular article of diet with the inhabitants of the steppes of Russia. To prepare it mare's milk is put into leathern bottles or earthenware vessels in which a little old koumiss has been left to start the fermentation, which is however sometimes induced by a mixture of flour, millet, honey, and yeast. The vessel is frequently shaken and the milk stirred. The koumiss that is formed after one day is mild koumiss, and has not much alcohol in it; that which is formed in two days is medium koumiss, and contains 1.65 per cent. of alcohol; in three days it is strong koumiss. Large quantities are drunk, often many pints a day. The inhabitants use it as a drink more than a food. It has a sour taste, a characteristic odour, quenches the thirst remarkably, imparts a feeling of high spirits and does not impair the appetite.

It is both diuretic and diaphoretic. The Russians attribute to koumiss great value in the cure of phthisis, and use it largely also for diseases, such as dyspepsia and anaemia, in which it is desirable to increase the nutrition of the body. It has also been employed successfully in infantile diarrhœa, and other gastro-intestinal diseases of childhood. References to Russian papers on this subject may be found in *Arch. für Kinderheilk.*, Bd. iv. s. 70-71.

In England koumiss is manufactured from cow's milk by the Aylesbury Dairy Company. They prepare a full koumiss containing the maximum amount of casein, a medium containing less, and a whey koumiss containing none at all; and also a Russian Aylesbury koumiss which is a very light preparation and can be used as a beverage. Each can be had in different stages of fermentation, the No. 1. being the most recently made, No. 2 is a little older, and No. 3 is the oldest. There is no doubt that these varieties of koumiss form nutritious, pleasant, stimulating drinks which are very easy of digestion, and can often be borne by the stomach when other forms of food cannot. I have seen cases of obstinate vomiting in which koumiss has been retained, although all other things that were tried were rejected, but I have likewise met with patients who could not be induced to take it.

Kef.—This is a preparation of cow's milk made in Russia in a manner similar to that used for preparing koumiss from mare's milk. A preparation called kef is sold in London, but how it differs, if at all, from London koumiss is not clear.

Whey Cure.—Whey consists of a solution of 4½—5 per cent. of sugar of milk, a little (1-2 per cent.) casein and butter, and about ½ per cent. of salts (chloride of potassium, chloride of sodium, phosphate of potash and soda). The remaining salts are left in the curds. The sugar of milk is a slight aperient and given in large quantities produces dyspepsia. The chief therapeutic value of whey lies in its salts, and it therefore is to be looked upon as a weak mineral water, but results that we might desire to produce by the salts are better obtained by mineral waters, for to give enough of the salts in whey so much lactose has to be administered that dyspepsia and nausea are produced. Therefore whey cures are becoming less and less popular, and the belief that the advantages of the whey establishments are due chiefly to their climatic influences and the careful diet enforced there is gaining ground. Nearly all continental baths and wells have a whey cure attached to them. Rehburg, elevation 900 feet, in Hanover; Streitberg, 1,800 feet high, in Switzerland; and Gleisweiler, 1,000 feet high in the Palatinate, are well known, but have no baths nor wells.

Whey is sometimes very useful when it is desirable to avoid the curdling of milk in the stomach, and I have often observed that patients much prefer a diet of cream and whey to one of pancreatised milk, which has an extremely bitter taste. I have found cream and whey useful for children in whom curds are vomited or passed from the rectum, in cases of gastric ulcer, and for dilated stomach. Perhaps also it would be advisable in typhoid fever to prevent the formation of curds, for it is just possible they may irritate the ulcers.

Grape Cure.—The Grape Cure is very like the whey cure, for it consists in the administration of a quantity of sugar and salts. The exact composition of the grapes varies in different establishments. It need not however be here considered, for grapes taken in large quantities have even to a greater degree all the evil effects of the whey cure, and the good effects that have been ascribed to the grape cure in cases of obesity are due to the slightly purgative effects of the grapes.

Braun says that dyspepsia and catarrh of the bowels are constantly the result of this treatment, and a case hardly ever occurs which would not have been better treated by mineral waters. From one to eight pounds of grapes are consumed daily. It is noteworthy that the results are best when but small quantities of grapes and plenty of ordinary food are taken. The best known places for this cure are Meran and Botzen in the Tyrol, Montreux and Bex near the Lake of Geneva, and Gleisweiler and Edenkoben in the Palatinate.

For further information consult :—

(1) Pavy. *A Treatise on Food and Dietetics.* *2nd Edit.* *London*, 1875.
(2) Bauer. *The Dietary of the Sick.* Von Ziemssen's *Handbook of General Therapeutics.* *English Trans.*, *London*, 1885-86.

CHAPTER VII.

DIET IN DIFFERENT DISEASES.

Acute Nephritis.—In this condition the chief danger is from uræmia: the diet should therefore contain but little nitrogen. Hence it is usual when the disease is at its worst to give nothing but farinaceous food, and always as far as possible the patient should be kept on this diet. If it becomes very irksome he may be allowed milk and fruits, but all meat and especially eggs must be avoided. Fats should not be given, as patients who are seriously ill find them difficult of digestion.

Chronic Nephritis, either tubal or interstitial. If the disease be severe and there is much danger from uræmia, a farinaceous diet is the most suitable. Dr. George Johnson and Dr. Ralfe have recorded cases showing the great benefit that patients suffering from chronic Bright's disease often derive from an exclusively milk diet, which may be absolutely adhered to for many months. The reasons why milk is suitable are numerous; it is very digestible, contains much fluid, has not much nitrogenous material in it, and lastly Dr. Carter, in his recent lectures (*Brit. Med. Journ.* Sept. 1, 1888), states that the urine of animals fed upon milk is much less poisonous than that of animals fed upon ordinary diet. If the patient will not submit to live upon milk only, or the case be not severe enough to render it necessary, the diet should be very easily digestible and contain but little meat. Eggs and cheese must be forbidden. The influence of alcohol upon the kidneys is, apart from its diuretic action, doubtful; still, as some authorities consider that it can cause chronic Bright's disease, it is better left alone. If it be taken, the more diuretic varieties, such as gin or whisky, should be chosen.

Chyluria.—Considering the great loss of fat in this disease, it is obvious that the sufferer should take as much fatty food as possible, such as plenty of milk, cream, bacon, &c.

Diabetes Insipidus.—The quantity of fluid drunk should not be restricted: a little lemon in the water, or oatmeal and water, help to quench the thirst. Such large quantities are taken, that fluids which are very hot or very cold, must be drunk in moderation. Diuretic beverages as tea, coffee, and alcohol should not be allowed unless they are very dilute.

Diabetes Mellitus.—It is well known that in this disease all articles containing sugar or starch should be discontinued. Dr. Pavy in his work on Diabetes gives the following list:

Dietary for the Diabetic.

May Eat.

Butcher's meat of all kinds except liver.

Ham, bacon, or other smoked, salted, dried or cured meats.

Poultry, game.

Shell fish (but not the liver), and fish of all kinds, fresh, salted, or cured.

Animal soups not thickened, beef tea, broths.

The almond, bran or gluten substitute for ordinary bread.

Eggs, cheese, cream cheese, butter, cream.

Greens, spinach, turnip tops, turnips,* French beans,* Brussels sprouts,* cauliflower,* broccoli, cabbage,* asparagus,* seakale,* vegetable marrow,* mushrooms, water cress, mustard and cress, cucumber, lettuce, endive, radishes, celery.

Vinegar, oil, pickles.

Jelly flavoured but not sweetened. Savoury jelly. Blancmange made with cream but not milk. Custard without sugar.

Nuts of any description except chestnuts. Olives.

Those marked with an asterisk may only be eaten in moderate quantity, and should be boiled in a large quantity of water.

Must Avoid Eating.

Sugar in any form.

Wheaten bread, and ordinary biscuits of all kinds.

Rice, arrowroot, sago, tapioca, macaroni, vermicelli.

Potatoes, carrots, parsnips, beetroot.

Peas, Spanish onions.

Pastry and puddings of all kinds.

Fruits of all kinds, fresh and preserved.

May Drink.

Tea, coffee, cocoa from nibs.

Dry sherry, claret, dry Sauterne, Burgundy, Chablis, hock, brandy, unsweetened spirits.

Soda water.

Burton bitter ale in moderate quantity.

Must Avoid Drinking.

Milk, except sparingly.

Sweet ales, mild and old, porter and stout, cider, perry.

All sweet wines, sparkling wines, port wine, liqueurs.

The advantage to be derived from this treatment is that under it the amount of sugar in the urine decreases, and all the symptoms in favourable cases improve. It is, however, very rare for the sugar in the urine of genuine diabetes to disappear entirely. Often the taking of a slight amount of sugar or starch in the food will increase the sugar in the urine out of all proportion to the amount of starch or sugar ingested. There are many slight cases of glycosuria, especially in old people, which may be benefited by a partial restriction of the saccharine and starchy articles of food, and by this means the sugar in the urine totally disappears. If it is determined to satisfy the great desire there always is for bread, some form that is slowly digested should be given. For this reason very hard dry toast is sometimes allowed, and as Dr. Ralfe points out new bread is preferable to stale. Those who find it irksome to forego the sweetening of foods may substitute saccharin for sugar.

Lithiasis, Gout, Uric Acid Calculi.—All observers are agreed that these conditions can be benefited by dietetic treatment, but hardly any two authors are in accord as to the best diet to be employed, nor is this to be wondered at when we consider that we have no certain knowledge about the pathology of the maladies under consideration. Some think that the ingestion of nitrogenous matter should be strictly limited, others look upon fats as very harmful, while many consider carbohydrates should be especially avoided, so that it is quite possible for a patient taking the counsel of three separate doctors to be completely starved. In spite of these discrepancies there are some points upon which all are agreed. They are as follows:

Moderation in diet is above everything desirable. Those who are liable to any manifestation of lithiasis should be much more careful than people ordinarily are never to surfeit themselves. Most patients when they first come under our care are eating too much, so the quantity of food must be diminished. They must not put themselves in temptation's way, and therefore should eschew dinner parties. Whatever is eaten must be light and easily digestible: consequently the diet should be simple, and all those substances which have been mentioned in the previous chapter as being difficult of digestion must be forbidden. Alcoholic drinks in all forms are bad, but although no doubt the alcohol in itself is harmful, for the temptation to excess may lead to serious results, the most pernicious effects of alcoholic beverages are probably due to their accessory constituents, otherwise it is difficult to explain why port, champagne, and beer are more deleterious than pure spirits. Perhaps it may be, as has been suggested, that the potency for harm of an alcoholic drink depends upon the degree to which it makes the urine acid, but it is doubtful whether this is the whole explanation. By far the wisest thing the patient can do is to become a teetotaller, but if he insist on drinking alcohol he must restrict himself to a little pure spirit, such as really good brandy, whisky or unsweetened gin, and any of them must be mixed with water. Of wines those which are least harmful are the lightest and purest, such as Moselle, or a very good but light Rhine wine or good claret. Port, sherry, Madeira, beer, cider, liqueurs, champagne, and all effervescing wines must be rigorously eschewed.

It is certainly right to keep the urine dilute, for by so doing the risk of the precipitation of uric acid either in the kidney or the bladder is diminished, the urine is less acid, and the tissues of the body are frequently completely washed out. The best means of compassing these ends is to frequently drink plenty of pure water; if this interfere with digestion it may be taken between meals, and as during the six or eight hours of sleep the urine remains for most of the time in the bladder, a long period is available for the precipitation of uric acid there; therefore a tumbler of water to dilute the urine should be taken before going to bed. Diuretic medicines are not to be given to produce diuresis, although occasionally they may be required for other properties they possess, for all the desired effects can be obtained by drinking water, and as we are ignorant of the exact action of diureties in disease, they may do more harm than good. Many of the watering-places such as Contrexéville, which are famous for the treatment of those who pass uric acid calculi, owe their popularity chiefly to the large quantities of water which the patients are compelled to drink.

The bowels must be kept efficiently and regularly open, for it is well always to get rid of the waste products from the body. This should if possible be effected without medicines. Plenty of exercise, whole meal bread and oatmeal are the best aperients, but if these should at times be powerless, mineral waters are to be preferred over ordinary drugs. Perhaps the best are Æsculap and Hunyadi Janos, enough being taken in a tumbler of warm water on rising in the morning to secure an easy action of the bowels after breakfast. Sir Henry Thompson advises that it should be combined with a few ounces of Carlsbad water, for many consider that this and other waters containing sulphate of soda are particularly beneficial for patients suffering from lithiasis, as it is extremely probable that in many cases the organ primarily at fault is the liver.

All these patients are better for some form of out-door muscular exercise which brings into play most of the muscles of the body. It is the physician's duty to insist on this especially, as often their habits are very sedentary. (P. 115.)

When we consider the kind of diet which we should advise we find ourselves in many difficulties. At first sight it might seem as though the best would be one without any nitrogen in it, for by strict adherence to this it is possible that the excretion of uric acid might be diminished; but we have seen that animals fed in this way die of starvation, so that we must allow some nitrogenous food and most authorities permit meat to be taken. The exact quantity allowed will differ in different cases, but in the greater number too much meat is habitually taken, and therefore the quantity allowed must usually be diminished, and obviously the more easily digestible it is the better, therefore fish and chicken are preferable to beef and mutton. If the patient cannot resist the temptation to eat too much he had better restrict himself to meat once a day, but if he can be trusted, he may be told to take it two or three times a day but to eat very little at a time, for then there is no period during which the system is flooded with proteid. At all meals there should be but few dishes, as the temptation to eat too much is thereby decreased. There is such a widespread and firm belief that fish, chicken and other easily digestible birds are superior to mutton, and especially to beef, that one cannot help thinking it possible that the form of albumen, apart from its digestibility, may be an important element in diet.

Authors differ very much with respect to the desirability of taking fats and carbohydrates. Some look upon them as very baneful, and give as a reason that the liver is well known to have an important influence upon nitrogenous metabolism, and that therefore it should not have too much work to do, and consequently as it aids the digestion of fats and is the storehouse of carbohydrates, the intake of these should be diminished. It is quite useless and totally unscientific to argue in this way, for, in the first place, this mode of reasoning would lead to the exclusion of proteids as well as fats and carbohydrates; secondly, we do not know that it is the hepatic nitrogenous metabolism that is at fault, for it may be the muscular; thirdly, it does not follow that because one function of the liver is disordered that others should be also. In the present state of our knowledge we must be guided entirely by clinical experience; and, unfortunately, the opinions of different authorities are not the same. Milner Fothergill thinks that butter and fat bacon are desirable foods for the gouty; Prof. Bauer, Sir Henry Thompson, and most other authorities consider that they should be strenuously interdicted. There is no doubt that most persons find many forms of fat extremely indigestible, as we see in the repugnance they show for broths and soups which have not had the fat skimmed off, and also often for very fat bacon. Then again, many affected with lithiasis are corpulent, and for them fat is obviously undesirable. Because therefore of its indigestibility, and because most authorities think it for other reasons injurious, the patient had better only take such fat as he gets in the milk he usually drinks and the butter he usually puts on his bread. If he is corpulent the reasons against his eating fat are still stronger.

When speaking of the various forms of carbohydrates as articles of food in lithæmia, writers frequently do not distinguish sufficiently between sugars and starches; but if a distinction is drawn, it is always stated that sugars are especially pernicious, and starches are permitted. Thus Professor Wood looks upon cane-sugar as the most harmful food a patient can eat, and Sir Henry Thompson forbids everything that contains it. The reason for this difference between starches and sugars is not evident, nor is it clear why cane-sugar is harmful. Perhaps it may be because sugar is a producer of fat, but if this were the reason starch likewise would be obnoxious. Whatever the reason may be, the clinical evidence about cane-sugar is stronger than about any other article of food; and therefore it and all substances containing it should be taken in strict moderation, or, better still, not at all. Whether this restriction should include grape and milk-sugar is doubtful, at any rate they are not so frequently forbidden as cane-sugar.

There is great divergence of opinion about milk and eggs as food for this class of patients. Some regard them as extremely unsuitable, others believe that benefit may often be obtained by using them largely. No doubt a few persons find them difficult of digestion, but if they can be taken it is hard to believe that articles of food so easily digested and assimilated can do much harm. Wood is strongly in favour of a milk diet in obstinate cases, and considers that with some persons of a gouty diathesis an exclusively milk diet is very beneficial.

Most vegetables, if they are capable ot easy digestion, are valuable, and this is especially true of green vegetables, lettuce, mustard and cress, and endive, so that a salad is a very good dish for the gouty patient, or one who passes much uric acid in his urine; one advantage at least is that this dietary renders the urine less acid.

The outcome of what has been said is that the diet should consist chiefly of vegetables which do not contain cane-sugar, of farinaceous articles of food, a little white meat, and such fat as is contained in butter and milk; but above everything, whatever is eaten must be taken in moderation. The quantity of the food is more important than its quality. It must not overtax the digestion, and rich substances must be rigidly excluded. No rules capable of universal application can be laid down, as the diet very suitable for one patient may be quite unfit for another. The physician must make the closest inquiry into the powers of digestion, mode of life, and previous habits of his patient, and diet him after a due consideration of all these particulars. It may rarely happen that the patient has been abstaining from food too rigorously, and that consequently he will be better for having his dietary extended.

During an acute attack of gout the sufferer should be kept strictly upon a farinaceous diet with simple diluent drinks. The importance of this is shown by a case that Sir Alfred Garrod relates in which an attack was kept up for six months because a little port wine was taken each day.

Oxaluria.—It is probable that the passage of an excess of oxalic acid in the urine with the tendency to the formation ot oxalic acid calculi, is closely allied to the excessive secretion of uric acid, and that the same causes will in some patients lead to the one, in some to the other. Consequently the treatment is the same in both conditions. The diet must be small in quantity and easily digestible in quality, all such things as pastry and other indigestible articles are to be avoided, and the kind of food should be the same as that advised for lithiasis. The urine must be kept dilute by drinking plenty of water, in order to avoid as far as possible any risk of the precipitation of oxalic acid, and all articles, as rhubarb, which contain it, are to be forbidden.

Functional Albuminuria.—This is frequently due to indigestion, and then is benefited by a dietary which corrects the dyspepsia.

Diet in Fever.—The following considerations should always be before us whatever may be the fever from which the patient is suffering. Much more urea is excreted than in health, and the nitrogenous metabolism is greatly augmented. This takes place both in the circulating and in the tissue albumen. There is also a greater metabolism of fats, but at the same time there is an increase of fat in the muscles, probably because their proteid material has split up into a urea and a fatty moiety. This development of fat in them explains their fatty condition, which we often see in those who have died during a fever, but much of this fat must be used up, because there is great muscular wasting. As one would suspect, there is an excessive excretion of carbonic acid gas. The temperature is raised, but its height bears no relationship to the excretion of urea. Lastly, the powers of digestion are very much enfeebled; this is doubtless chiefly due to the diminution in quantity of the digestive fluids. The scanty secretion of saliva which causes much thirst is a familiar example of this.

Although the administration of albumen increases the nitrogenous metabolism in health, yet Bauer and Künstle's experiments appear to show that its administration in fever saves to some extent the metabolism of nitrogenous tissues; be this as it may, it is obvious, if one may argue from healthy persons, that it will be advantageous to give fats and carbohydrates to fever patients, partly to save the proteid metabolism, and partly to compensate for the loss of fat. Senator recommends gelatin also in fever, because of its action in saving tissue metabolism. We see that the considerations are very complex, and what makes them more so is that often the temperature appears to be raised by giving food, but it is extremely probable that the capability of foods in this direction varies very much.

We must also remember in our attempts to determine the best diet in fever that digestion and absorption are much impaired; therefore a diet to be good must be plain, such as one consisting of from two to four pints of milk, and one or two eggs in the twenty-four hours. All food must be given in small quantities at frequent intervals, say every two hours, with, if necessary, liquor pancreaticus, barley water, or lime water, to prevent the curdling of the milk, although this is not often required if only a little be given at a time. There is no reason why, if he likes, the patient should not have a small amount of weak tea, coffee, or cocoa, to flavour the milk. Some of the many extracts of meat, meat juices, artificially digested meats or beef tea may be given, but it must always be recollected that the majority of these preparations contain no albumen, and are of value merely because they contain stimulating extractives (see p. 84). Jellies are often liked by fever patients, and there is no reason why they should not have them, for they are usually easy of digestion and pleasant to the palate, although not very nutritious. The distressing thirst may be relieved by an acid drink such as lemonade, or pieces of ice may be sucked. By either of these means the secretion of saliva is stimulated. A diet on the lines above indicated, fulfils, as far as we know them, the indications in fever, namely, the supply of easily-digestible food, sufficiently nutritious to compensate as much as possible for the tissue waste, but containing more fats and carbohydrates than proteids.

Convalescence.—Care must be taken that changes in diet are not made too suddenly. For example, the patient after a fever may first be allowed in addition to milk some farinaceous food; if this agrees, a few days later he may take some easily-digestible fish, as boiled whiting, or sole; in the next stage the flesh of some bird may be given—chicken is the least likely to disagree. After this point has been reached there is not much difficulty in proceeding to ordinary diet, but for some time only the more digestible foods should be eaten. If the fever has been severe, a large amount of tissue waste has to be made good, and therefore convalescent patients often take surprisingly large quantities of food.

Rheumatic Fever.—It is a matter of common experience that if the milk diet be left off too soon, both the pain and the fever are likely to return. The patient should be kept on this diet for at least ten to fourteen days after the fall of the temperature and cessation of the pain, and should the symptoms at any period of the convalescence show the slightest tendency to return, the exclusively milk diet must again be enforced.

Typhoid Fever.—The diet in this disease must be fluid and the chief part of it milk, but as the fluid diet has to be maintained for many weeks, it is especially important to prevent monotony, for patients often soon become weary of milk. This difficulty may be overcome by flavouring it with a little tea or coffee, adding a little brandy to it or beating up the yolk of an egg in it occasionally; or if the diarrhœa is not too severe beef-tea may be allowed, or a change may be obtained by sometimes giving mutton or veal or chicken broth, or milk and biscuit powder; in fact almost any slight variety may be introduced, provided that it be fluid and easily digestible. Dr. Goodhart would go further, and allow food which is not absolutely fluid provided that it be easily assimilable, and given with discrimination; he instances bread and milk and custard as articles which might be used (*Guy's Hosp. Rep.*, vol. xlv. p. 381). Both because of the liability to relapse and the danger of perforation, which may take place many weeks subsequent to the commencement of the disease, the patient must be kept on fluid diet for a long while after the temperature has fallen. If it be desired, either on account of the risk of perforation, or because of the vomiting, to prevent the curdling of the milk, this may be done by the addition of some of the substances already mentioned, such as lime water, barley water, liquor pancreaticus, or by giving cream and whey.

In typhoid as in other fevers the secretion of the digestive fluids is often partially arrested, and therefore some authorities recommend that a few minims of hydrochloric acid should occasionally be given, and it will sometimes be found an advantage to predigest the milk by the addition of a little liquor pancreaticus (p. 69). Many patients however dislike the resulting product very much on account of its bitter taste, which it is difficult to conceal by flavouring agents; for this reason the milk had better be only partially digested. Whatever food is chosen it should of course always be given at frequent intervals and in small quantities at a time. It is very important that the patient should have abundance of nourishment, and therefore it is the physician's duty to see that the milk used is good. I have known a case of typhoid fever do very badly, to every one's surprise, for the symptoms were moderate and the patient strong, till an analysis of the milk showed that it had been systematically diluted with equal parts of water by the milkman.

Acute Gastritis.—This is most frequently seen in its severest form as a result of poisoning by corrosive substances. After the administration of the antidote for the poison, the very simplest food, such as a little pancreatised milk with ice to suck, must be the only nourishment allowed. If the case be very severe no food should be given by the mouth but only by enemata. The principle of giving the stomach rest in acute affections of it cannot be too strongly enforced. The return to a normal diet must be made gradually; at first only very light substances such as arrowroot, custard, or biscuit-powder can be permitted.

Gastric Ulcer.—Precisely the same principles must be adopted in this disease. Both in gastric ulcer and acute gastritis perforation of the stomach always threatens, even when the symptoms are slight. Recently I have seen it happen after the swallowing of some acid by a child in whom the symptoms before the perforation were so slight as to excite little apprehension, and it has fallen to the lot of most physicians to see persons in whom no gastric ulcer was suspected die from rupture of its floor. Therefore if there be any evidence of a gastric ulcer, the patient must be most carefully dieted, only the plainest articles of fluid food should be given, and these by the method of very small quantities at frequent intervals. If the milk curdle in the stomach it should be predigested; if the case be at all severe nutrient enemata must be used, the only thing taken by the month being a little ice to allay thirst.

Typhlitis, Enteritis, and Inflammation and Ulceration of the Intestine of all Descriptions.—In all these conditions the dietetic principles are the same as in acute gastritis. The food must, as far as possible, be capable of complete digestion, so that there shall be but little hard fæces to pass over and irritate the inflamed surface, and for the same reason it ought to be fluid. By these precautions the danger of hæmorrhage and perforation is reduced to a minimum. Milk should be the chief food; beef tea and beer are usually undesirable on account of the diarrhœa they may cause. Typhlitis is particularly liable to relapse if the patient be allowed to get up too soon or to change from the fluid diet too early. He should not be permitted to have solid food, nor be allowed to get up, for at least ten days or a fortnight after the cessation of the symptoms.

Dyspepsia.—In many cases a cure can be effected by dietetic alterations, most of which have been already mentioned, but they are sufficiently important to warrant repetition. The food must be properly masticated, and if that is impossible it should be cut up into small pieces. The teeth must be in good condition. Long intervals between the meals are to be avoided; but too much food should not be taken at each meal, for an overloaded stomach is a frequent cause of indigestion. There should not be any great or prolonged exertion directly after a meal, nor should the body be thoroughly exhausted immediately before it, as by either of these errors blood will be withdrawn from the stomach. The dyspepsia from which some people suffer may be relieved by compelling them to take a rest before meals. Hard-worked business men who walk home in a state of thorough exhaustion may sometimes be cured if they ride home instead of walking. Food should be at a temperature of from 95-105° F., unless, as may be the case with water, it causes nausea if warm; it should be slowly eaten, and ought to be served up neatly and tidily so as not to disgust. Strong sauces and condiments are to be forbidden. Nothing should be taken between meals. Both in acute and chronic dyspepsia much good may often be done, unless the patient be weak, by commencing the treatment with a very limited and simple diet. The stomach, like other organs, is benefited by complete rest. I have recently had two cases of severe dyspepsia, both of which have been cured by putting the patient to bed and confining the diet to small quantities of milk given at frequent intervals. The mistake is often made of continuing the restricted diet too long; it must be remembered that digestion cannot go on properly if the body be underfed, and also that variety in food is essential. Experience has shown that milk and farinaceous foods are most easily digested, but if necessary they may be predigested. As the function of the stomach is to act upon proteids, the supply of them, when that organ is diseased, must not be excessive. A patient who was under my care had unsuccessfully tried all sorts of diet, but was completely cured by one of cream and whey together with a total exclusion of all other food. The previous chapter gives a list of the various foods, from which it will be seen that milk which has been prevented from curdling is the most digestible, that boiled whiting is the best of meats, that chicken is better than mutton, and that mutton is better than beef. All are agreed that in some forms of dyspepsia certain starches, such as potato, and large amounts of sugar are liable to undergo decomposition in the body, leading to the formation of acids which greatly increase the trouble. An excess of fats is prone to cause nausea and heartburn, and this is particularly likely to take place when the fat has been exposed to a strong heat. This is the reason that Dr. Pavy gives for the well-known indigestibility of pastry, which is of course much more indigestible if it is in thick, solid, heavy lumps than if it is light.

In any disease which causes a deficient flow of bile into the intestine fats must not be taken in large quantities.

If there be diarrhœa, fruits, brown bread, beer, and all other things which are known to cause it must be omitted, whilst in constipation they may be taken; but foods such as eggs and milk, which often constipate, must be avoided. Figs, prunes, tamarinds, dates, honey, and treacle are common examples of domestic purgatives.

No diet table can be given for dyspepsia because the cases are so unlike one another; but if the last chapter be consulted the different digestibility of the various foods will be seen, and these may be given in accord with the general principles just mentioned, regard being had to any idiosyncrasies that may be present. The advantages derivable from care in diet can hardly be over-estimated. The patient must conscientiously adhere to the directions given, and therefore it is generally advisable to write out a diet table for him to which he must conform. A moderate amount of exercise is desirable; some sharp game such as tennis is better for most than a monotonous walk, possibly because the quick movements facilitate the flow of bile from the liver.

Gastroectasis, or Dilatation of the Stomach.—Whatever may be the cause of this condition, the diet must contain only such articles of food as are not bulky and will not undergo gaseous decomposition; for the first reason but little fluid is to be drunk; and for the second, starchy foods must be taken very moderately. Vegetables are very bulky and aërated waters are obviously undesirable. The meals should be small and frequent, composed of articles very easy of digestion such as fish, fowl, or milk, and often predigested foods are of great service. For a cure it is, however, nearly always necessary to combine with dieting the washing-out of the stomach. (See Chapter XII.)

Anorexia Nervosa, Hysteria.—There are certain people, especially women, who waste to mere skeletons either from refusing their food, from vomiting it, or, in rare cases, from diarrhœa. No organic lesion whatever can be found to account for this condition. As an example of the third cause I may mention a young woman who was five feet six and a-half inches high, but only weighed 4 st. 9 lb. 12 oz. She had been under treatment several times for hysteria, she took very little food, and had severe diarrhœa. Such persons will recover completely if some one with a stronger will than the patient insist upon the food being taken; as a rule it is quite impossible to succeed unless she is entirely separated from her friends, and for a time seen only by the doctor and the nurse. I have known women with whom the treatment has been tried in the wards of a general hospital, where they were allowed to see their friends, and it completely failed; but directly they were removed to lodgings where they were isolated from all persons but the doctor and the nurse, they began to take large quantities of food, and to put on flesh rapidly. This was so with the patient just alluded to who had diarrhœa. It is a great mistake to suppose that there is anything special about the diet; the only essentials are to avoid anything indigestible, to administer the food at frequent intervals, and during the twenty-four hours to give a very large quantity. It is generally advisable to begin with milk, beef-tea, milk-puddings, and such easily digested substances, and gradually to employ those more difficult of digestion. Above everything, the doctor and nurse must be kind but firm and consistent in carrying out the treatment. Two examples will suffice to show the quantity of food which may be taken—thus Weir Mitchell on the tenth day was giving one of his patients the following:—6 A.M. ten ounces of raw meat soup. 7 A.M. a cup of black coffee. 8 A.M. a plate of oatmeal porridge with a gill of cream, a boiled egg, three slices of bread-and-butter, and cocoa. 11 A.M. ten ounces of milk. 2 P.M. half a pound of rump steak, potatoes, cauliflower, a savoury omelette, and ten ounces of milk. 4 P.M. ten ounces of milk, and three slices of bread-and-butter. 6 P.M. a cup of gravy soup. 8 P.M. a fried sole, roast mutton, French beans, potatoes, stewed fruit, and cream, with ten ounces of milk. 11 P.M. ten ounces of raw meat soup. As another example, I may quote one of my own patients who had vomited everything which she had taken, even including plain water, for nine months past. She was little more than skin and bone and so weak that she could not stand. She was isolated, and for the first ten days had nothing but milk in small quantities at frequent intervals; the sickness became gradually less and less, and by the tenth day it had stopped; she was then allowed in addition, porridge and bread and butter: by degrees various articles of food were added, until a month after the treatment began her diet was—6.30 A.M. tea, bread and butter, and jelly. 8.30 A.M. fish, oatmeal, bread and butter, and milk. 11 A.M. milk pudding, jelly, and a cup of coffee. 1.30 P.M. mutton chop, potatoes, greens, and milk pudding. 4.30. tea, and bread and butter. 6.30 P.M. mutton, greens, and potatoes, bread and butter pudding, cheese and biscuits; in addition, during the twenty-four hours she consumed two pints of milk.

She was now plump and strong, being able to walk a mile or two without getting fatigued.

Obesity.—Many diets have been proposed to reduce excessive corpulence. Some of the best known are the following:

Brillat-Savarin (*Physiologie du Goût*) considered that too much fat on the body was due to an excess of farinaceous food. He allowed meats, green vegetables, jellies and fruits, but, like all authorities, forbade beer.

Moleschott and Chambers both prohibited fat also, and recommended diets chiefly consisting of meat.

The most celebrated dietetic treatment is that known as the Banting method, from the fact that Mr. Banting, who dieted himself on the recommendation of his doctor, W. Harvey, published an account of it. By restricting himself to it he reduced his weight from 14 st. 6 lb. to 11 st. 2 lb. in about a year. The diet consisted of—Breakfast, 9 A.M. Five or six ounces of either beef, mutton, kidneys, boiled fish, bacon, or cold meat of any kind, except pork or veal, a large cup of coffee or tea, without milk or sugar, a little biscuit, or one ounce of dry toast. Dinner at 2 P.M. Five or six ounces of any fish except salmon, herrings or eels, any meat except pork or veal, any vegetable except potato, parsnip, beet-root, turnip or carrot, one ounce of dry toast, fruit not sweetened, any kind of poultry or game, and two or three glasses of good claret, sherry or Madeira; champagne, port, or beer being forbidden. Tea at 6 P.M. Two or three ounces of cooked fruit, a rusk or two, and a cup of tea without milk or sugar. Supper at 9. Three or four ounces of meat or fish similar to dinner, with a glass or two of claret or sherry and water.

This diet has been severely criticised. Dr. Pavy many years ago showed that in the first place much of the good which Mr. Banting derived was due to the fact that previously his diet was one which would have been chosen if the desire had been to make him corpulent, and in the second place the diet he adopted was very restricted, so that as compared with a healthy man he was considerably starved, for although he was taking exercise, he ate only about twenty-four ounces of solid food, of which about half was water, and drank thirty-five ounces of fluid, whilst the minimum average diet of a healthy man even if he take no exercise should contain about thirty ounces of solid food of which only fourteen are water.

Those who have had much experience of the Banting method have found that there are many objections to it. Frequently it soon produces loathing of food and such severe indigestion that it has to be discontinued. The patients often feel very chilly, and there is an irresistible longing for hydrocarbons. The large amount of nitrogen consumed, and the small quantity of fluid taken both lead to the development of gouty attacks in those who are predisposed to gout. Lastly it has been stated, although perhaps upon insufficient evidence, that the extra work thrown upon the kidneys by the largely increased excretion of nitrogen leads to chronic Bright's disease.

Cantani's diet, which consists of lean meat only, is clearly to a still greater extent open to the objections that have been urged against the Banting method.

Ebstein (*Corpulence and its Treatment*, by Dr. Wm. Ebstein, translated from the sixth German edition by Prof. A. H. Keane, Wiesbaden, 1884) has tried so to arrange a diet that it shall not be open to all the faults of Banting's. The principle point in which he differs from Banting's diet is that he allows some fat; by this means he claims to avoid the loathing caused by the more exclusively nitrogenous diet: he considers also that less proteid will be required, for fat, as we have seen in the last chapter, retards nitrogenous metabolism, which, according to the teaching of physiology, itself leads to the formation of some fat. He prescribes the following diet:—Breakfast 7.30 A.M. About half a pint of black tea without milk or sugar, two ounces of white or brown bread toasted, with plenty of butter. Dinner about 2 P.M. Soup often with marrow, from four to six ounces of roast or boiled meat, vegetables, preferably leguminous, in moderation, but also cabbages. Turnips and potatoes excluded. For the second course a salad, or occasionally some stewed fruit without sugar. After dinner a little fresh fruit. During dinner two or three glasses of light wine. Immediately after a large cup of tea without sugar or milk. Supper about 7.30 P.M. A large cup of black tea without milk or sugar, an egg, or a little fat roast meat or both, or some ham with its fat, Bologna sausage, smoked or fresh fish, about one ounce of white buttered bread, occasionally a small quantity of cheese, or some fresh fruit.

The following contrast made by Dr. C. Zahn of Banting's and Ebstein's diets may be found useful. I quote from Professor Wood's *Therapeutics, its Principles and Practice*, 7th edition, London, 1888, for there a normal diet also is given. The average amount of food required by the human adult is generally acknowledged by competent authorities to be about as follows :—

	Albuminous Materials.	*Fat.*	*Starchy Hydrocarbons.*
	30 drachms.	25 drachms.	92 drachms.
Banting's diet contains,	45 drachms.	2 drachms.	5¼ drachms.
Ebstein's diet contains,	25½ drachms.	21¼ drachms.	11¾ drachms.

Oertel's method of the treatment of obesity will be found in Chapter V., where the objections to it are set forth. He differs from all others in allowing hydrocarbons instead of fats to protect the albuminous metabolism, he restricts the quantity of fluid more rigorously than most other authors, and he is a great advocate for taking excessive muscular exercise, especially by mountain climbing.

Professor Wood quotes from a little book called *Advice to Fat People,* which relates how the author, who does not reveal his name, reduced his weight a hundred and seventeen pounds and his girth seventeen inches in ten months. He took the following diet: 6 A.M., one pint of black coffee and one ounce of coarse brown bread or biscuit; 9 A.M., four ounces of lean meat, three ounces of brown bread or biscuit, and half a pint of coffee; 2 P.M., six ounces of lean meat, three ounces of brown bread or biscuit, six ounces of vegetables, and half a pint of any fluid except ale, effervescing wines, or aerated water, followed by half a pint of coffee; 6 P.M., half a pint of coffee. At supper two ounces of brown bread or biscuit, and a couple of glasses of sherry or claret. Fruit *ad libitum;* liquorice powder as required.

Towers-Smith has recently, in the *British Medical Journal* for October 6th and November 10th, 1888, recorded the results of his method, by which he has succeeded in reducing the weight of several corpulent persons. For the first fourteen days of the treatment he allows nothing but lean meat to eat and hot water to drink. He himself took the following: Breakfast, one pound of rump steak without fat. Lunch, another pound of rump steak. Dinner, one pound of grilled cod, and one pound of rump steak. He drank at intervals during the twenty-four hours a gallon of hot water, and the last thing at night he took two tablespoonfuls of whisky in cold water. During the fourteen days he lost eighteen pounds. The second period lasts twenty-one days; the diet is more varied, the hot water is reduced to four pints in the twenty-four hours; other kinds of meat, as mutton chops free from fat, chicken, turbot, whiting, or soles, a little green vegetable, and some slices of plain unsweetened rusk are allowed. During this period he lost sixteen pounds. The third epoch consists of thirty-one days, the hot water is reduced to about a quart, tea is allowed, with the bottom crust of a stale loaf, captains' biscuits, fish, fowl, game, any joint, some claret or hock, and seltzer water. During this period he lost seven pounds. After this ordinary diet may be taken. Five grains of bicarbonate of potash are given night and morning. The disagreeable taste of the hot water is concealed by the addition of a slice of lemon. If there be much repugnance to the meat it may be prepared as follows: Take four pounds of beef free from fat, cut it up into pieces an inch square, place it in an air-tight jar, set the jar in water and let it boil constantly for six hours. Then pass the result through a sieve, take four ounces of what remains behind on the sieve, pulverize it in a mortar, and mix with the juice which passes through. Take a fourth part of the mixture at each meal.

It will be noticed that the chief part of this treatment is the strictly nitrogenous diet for a short time only, during which large quantities of water are drunk. As the period is so short, the repugnance to meat of which patients on the Banting system complain does not seem to have time to appear, and as so much water is drunk, the whole of the excess of the products of nitrogenous and fatty metabolism are probably kept diluted and passed out in the urine. None of Towers-Smith's patients had dyspepsia as a result of treatment. Others who have since tried the method successfully have recorded their results in subsequent numbers of the *British Medical Journal.*

If we look back upon the diets that have just been given we observe that the principle of them all is the same—namely, a considerable reduction of fats and carbohydrates, and a more or less exclusively proteid diet. This is physiologically correct, for we have seen that fats and carbohydrates are the chief formers of fat, and that if they be withheld the body lives on its own fat.

In treating a case it is wiser not to imitate slavishly any particular diet table, but bearing in mind the principles of them all the physician should draw up a table which is suitable to the particular case before him, recollecting Ebstein's rules, which are—(1) The diet must be one that leads to no unhealthy craving. (2) It must be possible for the patient to go about his ordinary occupation whilst on it. (3) It must be capable of being maintained for some time. This last, perhaps, would hardly apply if Towers-Smith's plan is adopted.

With the exception of Towers-Smith, all make a great point of restricting the quantity of fluid drunk. This is probably a mistake, and all the reasons which have been urged in its favour reveal an erroneous knowledge of physiology; in reality there can, I think, be but little doubt that it is an advantage to take large quantities of water, for as we wish to accelerate destructive metabolism, it seems but natural that we should, as quickly as possible, try to wash out all the products of destruction. By permitting, or better still by enforcing, the drinking of a great deal of water we prevent the thirst of which patients so often complain. The diet for the reduction of corpulence should not contain any alcohol, for it can do no good, and many forms of it, as sweet wines and beer, lead to a rapid accumulation of fat. If the patient insist on taking it, a little pure spirit and water is the best he can drink.

Whilst under treatment, and also when it is over, he ought to take sufficient muscular exercise every day to thoroughly tire him, for it is a well-known fact that muscular work increases fatty metabolism; but it must be carefully remembered that persons differ very considerably in the amount it takes to tire them, and the physician should use great judgment in this matter. The exertion should be uniform, prolonged, and must bring into action most, if not all, the muscles of the body. Rowing is the perfection, and perhaps the next best are gymnastics, running, climbing, walking, and riding. Solitary exercise, such as walking, is no rest to the mind, for it is not taken out of its usual groove as it is during games or in company, and there is a great likelihood of over-exertion, owing to the temptation to cover some enormous distance. It is desirable that while taking exercise free sweating should be induced, and to prevent catching cold woollen substances should be worn next to the skin. There is no harm, but probably good, to be derived from an occasional

Turkish bath, for the perspiration is one means by which waste products may be eliminated. The reader need hardly be reminded that before prescribing exercise to the corpulent, great care must be taken to make quite sure that there are no indications of a fatty heart, or any circulatory derangement, for if these exist the exercise must be altogether forbidden or most cautiously regulated. Want of forethought in this matter has more than once led to the most dangerous symptoms, and even sudden death. It is generally advisable to let the exertion be gradually increased day by day.

Most persons find it pleasanter to make the reduction in the diet by degrees. Even although it consists chiefly of proteids, it will often be necessary to diminish the amount of meat as well as of fat and carbohydrates, for usually these patients eat too much of everything. They should be weighed before the treatment and frequently during it, and it is advisable also to weigh the food taken at each meal.

Scurvy.—It is well known that the efficient cause of scurvy is the want of fresh greens, potatoes, or certain fruits, especially oranges and lemons, also that it is much more liable to break out among those who are fed on salt meat, or live in confined quarters. The preservation in the fresh condition of antiscorbutic articles of diet does not impair their power of restricting this disease. Lime juice or lemon juice can efficiently replace them. Leguminous vegetables and cereals will not prevent scurvy. The most probable theory is that antiscorbutic vegetables owe their properties to the salts of potash they contain, but that those salts which pass out unchanged in the urine are of no antiscorbutic value. This theory originated with Garrod, and according to Fagge it was Chalvet who first showed that salts which passed out unchanged were not efficient. It is clear that the right treatment for scurvy is to feed the patient on antiscorbutic diet, and to give him lemon juice or lime juice, and also to aid the recovery by good food, abundant fresh air, and healthy sanitary conditions. To prevent scurvy, antiscorbutic foods must be given continuously. Pickled vegetables will even act efficiently. There is a story of a captain who had some pickled onions which he ate largely, and greedily kept all to himself during a voyage; he alone of all those on board escaped scurvy.

Tufnell's Diet for Aneurism.—The object of this method of treatment is, by diminishing the solid and fluid food, to render clotting in the sac of the aneurism more easy. The diet advised by Tufnell is: Breakfast; two ounces of bread and butter, and two ounces of milk or tea. Dinner; three ounces of mutton and three ounces of potatoes or bread, and four ounces of claret. Supper; two ounces of bread and butter, and two ounces of tea: in all ten ounces of solid and eight ounces of fluid in one day. This diet must be combined with rest in bed, and should last for two months at least. Although often valueless, sometimes successful results are obtained. Patients should have their ordinary diet gradually decreased, and if they cannot endure having so little food as Tufnell advises they must get as near to it as they can, but I have often been struck with the comfort with which they take the restricted diet.

Skin Diseases.—There is a general belief that these diseases require special dietetic treatment, but this is not so for at least the majority of them. Some, as for example acne rosacea, and certain forms of erythema, especially urticaria, are due to disorders of digestion, and therefore the patients must be dieted according to the form of dyspepsia from which they suffer, and all spices, pastry, rich substances, and indigestible foods, must be especially interdicted. Acne rosacea is particularly connected with over-indulgence in alcohol.

If the disease be acute, such as acute eczema, the patient ought, as he would in any other acute affection, to be put upon a milk and farinaceous diet.

In chronic eczema Dr. Pye-Smith and other authorities consider that all foods such as salt meats, ham, and cured fish, cheese and spices, should be avoided, and in certain cases alcoholic liquors. Anything which experience shows produces indigestion must of course be forbidden.

Children.—For a short time after the child is born it requires no food, but when about three hours have elapsed it should be put to the breast, for suckling aids the contraction of the uterus, prevents sinking of the nipple, and the colostrum purges the child slightly. The mother ought to lean over and support the breast to keep it steady, allowing the nipple to fall into the child's mouth. Feeding should take place at regular intervals; every two hours during the daytime for the first six weeks, and every three hours afterwards. The last meal should be at 11 P.M., and the next at 5 A.M. For the first six to eight months the child should have nothing but milk. Whilst she is suckling her infant the mother must see that she takes plenty of fluid, which should be nutritious: cocoa and milk are therefore to be recommended; her diet must be liberal and easy of digestion; any dyspepsia must be at once corrected, and she must keep in good general health. It is well known that drugs given to the mother will affect the child, and infantile maladies may be sometimes traced to errors in diet on the part of the mother, such as diarrhœa in the infant due to her taking too much beer, and dyspepsia due to her eating largely of indigestible food.

At from the sixth to the eighth month the child may have two meals a day of some good farinaceous food, such as Savory and Moore's, Liebig's, Nestlé's, Allen and Hanburys', Mellin's, or Chapman's entire wheat flour; it should be prepared with cows' milk, but the other meals are still to be of mother's milk.

At the ninth month the infant ought to be gradually weaned, and milk and water in such proportion as it is found the child can digest should be substituted for its mother's milk. Six meals a day should still be allowed.

At from the tenth to the twelfth month, for the midday meal the child may have a teacupful of beef-tea, milk with the yolk of an egg beaten up in it, or veal, mutton, or chicken broth. The milk meals should go on as before. A hard crust, or a rusk, or a piece of dry toast may be given once a day to help the development of the teeth.

After the twelfth month a breakfast of bread and milk may be gradually introduced, or the yolk of an egg or some bread and butter may be taken. For the midday meal, in addition to the broth, a little plain milk pudding may be given, and occasionally a mealy potato, or the flower of a well-cooked cauliflower, with a little gravy free from fat. Four or five meals a day are required; the other two, at about 10.30 A.M. and 6 P.M., may consist of milk and one of the infants' foods, or milk and bread and butter.

After the age of eighteen months a little meat may be taken. Dr. Goodhart (*Diseases of Children*, 3rd edit., Lond., 1888) gives the following diet for a healthy child at this age: Eight A.M. A breakfastcupful of bread and milk, or thin bread and butter, and the yolk of an egg and some milk. A drink of milk, and a rusk during the morning. Half-past one.—A tablespoonful of pounded mutton with some mashed potato and gravy, and a little toast and water to drink, or a cup of beef-tea in which some vegetable has been stewed. Five P.M.—A breakfastcupful of milk, thin bread and butter, and thin sponge cake. No dietetic rules for the more advanced ages of healthy children are necessary; the meals should be made up of the easily digestible articles already mentioned. With children as with adults the hours of meals must be regular, and there ought to be no eating between times. Generally speaking, children will, with a little persuasion, take most suitable articles of food, but things which they obviously dislike ought not to be thrust upon them. That which they find repulsive cannot as a rule be digested.

If the mother be unable to suckle the child the best substitute is artificial human milk. It is prepared by the Aylesbury Dairy Company, who will deliver it twice a day in London, or send it into the country three times a week. Should this be unattainable the child may have cows' milk slightly warmed and mixed at first with an equal part or even a larger proportion of water, and sweetened with a little sugar; the reason for this is that human milk contains much less proteid than that of the cow, but is considerably sweeter. The feeding-bottle and all its parts must be kept scrupulously clean; therefore the simplest, being the easiest to cleanse, are the best. Those with long india-rubber tubes are very objectionable. The tropical feeding-bottle is a good example of those that have few parts that can get foul. Directly it is done with it must be cleaned, and when not in use should lie covered in a basin of water, together with the nipple, screw, cleaning-brush, and cup in which the milk is measured. The water may be kept sweet by adding a little borax, or, as recommended by Dr. Goodhart, salicylate of soda, in the proportion of four grains to the fluid ounce. It is a good plan to have two bottles, and to employ them alternately. The saucepan in which the milk is warmed ought to be thoroughly rinsed out directly after use. Attention must be paid to the nipple, to see that it neither allows the milk to be taken too fast, nor makes the sucking of it too difficult. Children should not be allowed to suck their milk rapidly, as this causes vomiting.

Often milk and water gives rise to the vomiting of curds. In this case the quantity of water added to the milk must be still greater, or lime-water or barley-water may be substituted for it, the quantity being the same as that of the water, or a little of one of the foods previously mentioned may be added. Sometimes condensed milk may be found to suit best; a tea-spoonful of it to a teacupful of water is enough for a meal, but as soon as possible the child should again take to cows' milk. As the curd is the great difficulty in digestion, it may be replaced by cream and whey or by "strippings," which consists chiefly of cream and whey, and is the milk that is obtained by remilking the cow directly after the ordinary milk is withdrawn. It may, in severe cases, be found that a wet-nurse is necessary. In all cases of difficulty the best treatment is, if possible, to get the child to take artificial human milk; if it cannot be obtained the following directions for making it may be followed:—Take half a pint of skimmed milk, heat it to about 96° F., and put into the warmed milk a piece of rennet an inch square, or a teaspoonful of essence of rennet. Put the milk in a fender or over a lamp until it is quite warm. As soon as it is set remove the rennet, break up the curd into small pieces with a knife, and let it stand for ten or fifteen minutes, the curd will then sink. Then pour the whey into a saucepan, and boil quickly. Measure one-third of a pint of this whey, and dissolve in it while it is hot 110 grains of sugar of milk. When this third of a pint of whey is cold add to it two-thirds of a pint of new milk and two teaspoonfuls of cream, and stir. The food should be made fresh every twelve hours, and warmed as required. The piece of rennet when taken out can be kept in an egg-cup and used for ten days or a fortnight. These directions seem very complicated, but I have easily trained nurses to carry them out, and when done systematically they do not take much time. Essence of rennet may be used, as it is more convenient than pieces of rennet. There are many essences in the market; care must be taken to choose a good one which does not make the milk taste. It is very much cheaper to prepare this artificial milk at home than to buy it.

Many infantile diseases are due to improper feeding, and therefore the first thing to be done is to institute a suitable diet. It is often well to give a few doses of castor-oil in order to clear away any indigestible food, which may be the source of diarrhœa, constipation, flatulence, or colic. Two other points are to be insisted upon—namely, that the whole of the body of the child must be kept warm, and also that all dietetic changes must be made gradually. Children should wear long sleeves, high-necked frocks, and drawers, if not in long clothes.

When there is slight constipation, the addition of barley-water to the milk, or a teaspoonful of fine oatmeal thoroughly mixed with a little milk may be given once a day, preferably in the morning. We ought not to treat, unless absolutely necessary, the constipation which follows diarrhœa, or the old trouble may be again induced.

Diarrhœa may often be cured by an alteration in the diet. Barley-water, and veal, mutton, or chicken broth, carefully skimmed of all fat, and made of such a strength that when ready for use a pint of broth corresponds to a pound of meat, are useful for stopping it, and one or more meals of them may be substituted for milk ; but if the diarrhœa is very severe, at first but little food is required, for all that is taken sets up vomiting and purging. If the collapse be great a few drops of brandy every hour should be administered. For intractable cases of chronic diarrhœa raw meat is the best diet. It should be prepared as follows :—Take a lean piece of beef or mutton, and after cutting it into small pieces reduce it to a thick pulp with a pestle and mortar. Pass the pulp through a fine sieve, sweeten with a little sugar that which comes through, together with that which collects on the under surface. A teaspoonful of this is to be given thrice daily, and the quantity should be gradually increased as the patient recovers. Dr. Goodhart recommends that for older children it should be stirred up with a little thin barley-water, or cold veal broth, or mixed with chocolate, or red currant jelly. In any of these ways it is rendered less liable to excite disgust. Before this diet is adopted a fair trial ought always to be allowed to good artificial human milk. Whatever food is employed it must be given in small quantities at a time, and the child must be made to feed slowly. It ought to be warmly clad, and wear a flannel band round the abdomen, however slight the diarrhœa. The treatment by washing out the stomach is referred to in Chapter XII., and that by koumiss in Chapter VI.

Dietetic errors are the chief cause of rickets, therefore the obvious remedy is to return to a diet suitable for the child's age, remembering that the disease has often so retarded the whole development that the child cannot digest such food as that which can be digested by a healthy child of the same age. In such a case simpler food than the age appears to warrant must be prescribed, and it should be abundant. The same lines of treatment must be followed in acute rickets. Dr. Goodhart says that in this disease the most important point is that there should be variety in the diet, and he recommends as particularly useful raw beef juice, under-done pounded meat, cauliflower, julienne, orange juice, and milk.

CHAPTER VIII.

ON THE DRINKING OF WATER.

THE subject of this chapter will be dealt with by first considering the action upon the body of the water drunk, then that of its separate constituents, and finally the conclusions at which we arrive will be applied to disease.

The effect of the act of drinking must, as Lauder Brunton points out, always be recollected. With some persons it can be observed that after sipping a glass of water slowly, there is a rise of several beats in the rate of the pulse, but after drinking it at one gulp there is hardly any alteration. This powerful stimulation of the circulation is due to the fact that sipping, or sucking, partially abolishes the restraining influence of the vagus on the heart. The cerebral vessels participate in this stimulation, as may be shown by taking tracings from the fontanelle of an infant before and during the act of sucking. (Fig. 2.)

Thus we have explained to us the well-known circumstance that with some persons a glass of beer or wine more readily gets into the head, if it be sipped or sucked through a straw, than if it be drunk at a draught. The pressure of the bile in the excretory ducts of the liver, and presumably therefore its rate of flow into the duodenum, are raised by the action of sipping, hence probably the advantage of taking cholagogue waters in this way.

Many observations have been made with the object of showing how the temperature of the body is influenced by drinking cold water; a large number are untrustworthy, as the thermometer was put into the mouth immediately after the water had gone through it, but Liebermeister in 1859 showed that the temperature in the axilla sank 1½° F., as the result of drinking a pint and a half of water at 42° F. in two portions at intervals of half an hour. Winternitz has confirmed these results, and has further shown that the rectal temperature may fall considerably more than the axillary, and that the temperature of the voided urine is less than it was before the drinking. A slight sinking of the temperature of the stomach can be produced by drinking cold water. By making the patient swallow a thermometer attached to the end of an india-rubber tube Winternitz demonstrated that three hours afterwards the organ had not quite regained its temperature. The depressions brought about by the administration of enemata of cold water are similar, save that the sinking of the temperature in the rectum is greater.

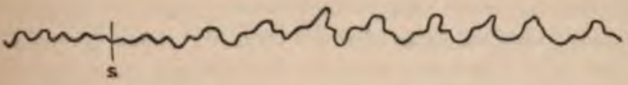

FIG. 2.—Tracing from the fontanelle of an infant six weeks old. At S the child began to suck. Not only is the amplitude of the waves greater, but the line of the tracing rises, indicating increased circulation in the brain.—Salathé, in Marey's *Travaux* for 1877, p. 354 (referred to by Lauder Brunton).

The drinking of cold water produces sometimes a less, sometimes a greater frequency of the respirations, and retardation of the pulse; thus, in one of Winternitz's experiments, a litre of water, taken at a temperature of 43° F., induced a fall of the pulse from 72 to 52, and the respirations rose five. These alterations appear very quickly, and soon pass off. The drinking of cold water leads to greater tension of the radial pulse, but warm water lowers it. The temperature of the water must be so low, or its quantity so great, to cause effects of any duration on the bodily temperature, pulse, or respiration, that it is not used for these purposes. Warm water, as is well known, gives rise to nausea and vomiting, but curiously enough, it will if given in small quantities sometimes stop the sickness that comes on subsequent to the administration of chloroform.

Water that has been drunk is rapidly absorbed, probably chiefly from the stomach, and it is so quickly excreted by the kidneys that there is no variation in the quantity of the blood. The amount of urine secreted is increased, and so also —according to Braun—are the bile, pancreatic juice, and saliva, although not to so marked a degree. The effect upon the excretion of water by the sweat glands, or lungs, is variable, for this depends on the state of the surrounding atmosphere. The greater secretion of bile may perhaps explain the occasional purgative action of water, which however also operates by increasing peristalsis, especially if it be cold. Some people find a glass of it taken on rising in the morning quite sufficient to produce an easy movement of the bowels. It is absorbed most readily when at the temperature of the stomach, and also when that organ is empty. These are the reasons why mineral waters are best mixed with warm water, and taken before breakfast. Warm water leaves the stomach more rapidly than cold, but the absorption of either is said to be retarded if large quantities are drunk at once. Winternitz states that the rate of absorption is increased by severe losses of fluid, such as diarrhœa, hæmorrhage, profuse sweating, or polyuria, and as evidence of the rapidity with which water leaves the gastro-intestinal tract he quotes Bouisson, who saw the portal vein of a dog very distended soon after the ingestion of a considerable quantity of water.

Cold water acts on the gastric mucous membrane as on the skin, for it first contracts the vessels which afterwards during the period of secretion dilate. It might be thought therefore it would be a good carminative, and stimulate the appetite; some persons find it so, and are enabled to digest their meals better if they take a glass of cold water shortly before them, ut there are great individual differences, and many believe digestion is more easily performed if they take warm water. however really acts in the same way, for it dilates the without any previous contraction. Others, again, are they do not drink at all during meals. Large ties of fluid taken with food are probably bad for all s, but most can take soup at dinner and tea or coffee kfast. Braun considers that if a meal be chiefly albu- us, water should be taken during it, to aid the gastric igestion; but if it be fatty, water should be drunk some time after it to aid intestinal digestion. Inasmuch as peculiarities are numerous, and we lack exact information, generalizations on all these points are impossible.

If a great quantity of water is drunk, more than the usual amount of urea is excreted, and there is a diminution even to the point of complete disappearance of the uric acid. Braun concludes from this that, by drinking much water, the last results of tissue metamorphosis, and consequently its completeness, are increased. There is an additional amount in the urine of sulphuric and phosphoric acids and chloride of sodium. Some authors assert that the increase of all these constituents is due to the washing out of the tissues, but the great majority say that the drinking of much water renders the tissue metamorphosis more thorough, and perhaps causes more of the tissues to be metabolised. It is even stated that those who lead a sedentary life may, by drinking plenty of water, attain in some measure that feeling of health and exhilaration which follows the taking of exercise. The benefits derived at many places where waters are drunk should probably be attributed more to the water than to the substances in it.

In a recent debate at the Pathological Society, Dr. Pitt showed by statistics collected from the records at Guy's Hospital that the kidneys of patients who drank copiously of alcohol were considerably hypertrophied, and this is also true of those dying from diabetes. This hypertrophy is attributed to the great amount of fluid passing through these organs. Whether they also increase in weight and size in those who drink largely of water we do not know, nor whether hypertrophy of the kidney ever leads to any serious structural damage of its tissue; probably not, for albuminuria is rare in diabetes, and when present it only comes on towards the end of life, at the autopsy only slight epithelial changes are found, and often the organ is healthy.

The constituents of any spring act precisely as such drugs do under any other circumstances; these actions, as, for example, those of iron, sulphate of soda, or carbonic acid gas, will be found in ordinary works on therapeutics. Any remarks which need be made in this book will be mentioned when treating of the classes of waters. As before stated the advantages of many mineral springs do not lie, as those pecuniarily interested in the Spas are always proclaiming, in the substances in solution in the water, but in the altered diet, compulsory holiday, exercise, fresh air, regular hours, mental rest, the enforced breaking of pernicious habits, and, if much water is drunk, in its quantity, apart altogether from the substances in it. That this is so will be evident on looking at the composition of many of the springs, for their salts are present in such minute quantities that even when large doses of the water are drunk, the amount of the salt taken is so small that it can have no appreciable effect. There are some exceptions, which will be considered in the following pages.

A.—Waters containing Carbonic Acid Gas.

A solution of this gas taken into the mouth causes a pricking feeling there; it stimulates the secretion of saliva, and so quenches thirst better than plain water. It produces a pleasant sensation in the stomach, and increases its peristaltic movements as well as those of the intestine. It gives rise to hyperæmia of the gastro-intestinal mucous membrane, to which it is a slight local anodyne, and is therefore valuable when there is gastric pain or irritability. Its diuretic power is undoubted, for a given quantity of water causes a smaller secretion of urine than a similar quantity of water in the same time if impregnated with the gas. According to Quincke, the reason is that the gastro-intestinal hyperæmia facilitates the absorption of water. As Leichtenstern says this may explain how it is that alcoholic drinks containing carbonic acid gas are more intoxicating than those which do not. The carbonic acid gas held in solution by any water does not alter to an appreciable extent the quantity in the blood, nor the condition of the pulse, blood pressure, or respiration.

Aërated beverages may be prescribed for dyspepsia, especially when from any cause whatever there is pain, nausea, or vomiting. We constantly find that in many diseases, as for instance peritonitis, patients can retain nothing but milk and soda-water or champagne. Mineral waters having much of the gas in them are diuretic, and pleasant for those who are very thirsty.

The following table gives the amount of carbonic acid gas in cubic centimetres per litre :[1]—

Name.	Situation.	Amount.
APOLLINARIS	Ahr Valley	1521
MARIENBAD (summer) (Carolina Well)	Bohemia	1514
REINERZ (Cold Well)	Silesia	1465
WILDUNGEN	Waldeck	1322
TEINACH (Bach Well)	Würtemberg	1235
CUDOWA	Silesia	1198
MARIENBAD (Ambrosius Well)	Bohemia	1173
IMNAU	Würtemberg	1160
SCHWALBACH (summer) (Linden Well)	Hesse Nassau	1000
TARASP (Kardla Well)	Engadine	892

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[1] In all the tables in this chapter the season is, where necessary, put in brackets after the name of the place.

The KRONDORF water, which contains large amounts of carbonic acid gas, has been recently introduced into this country. It is drawn from a spring near Carlsbad. There are many other wells whose waters hold in solution less carbonic acid gas than those mentioned here. They will be found under the heading of the most important of their constituents. MONT DORE in Auvergne has a spring with much carbonic acid gas in it, but it is classed by Leichtenstern among the indifferent thermal waters. Some of the CARLSBAD springs are impregnated with this gas, which is stated to be the cause of the benefit that diabetic patients are said to derive from going there.

B.—Waters containing Bicarbonate of Sodium as their Chief Ingredient.

The therapeutical action of these is the same as that usually ascribed to bicarbonate of sodium. The reader need only be reminded that this drug favours the secretion of the gastric juice if taken before a meal, but neutralizes it if taken after. It probably also stimulates the peristaltic action of the stomach and intestines, and certainly aids the removal of mucus from them. Its purgative action is much slighter than, but similar to, that of sulphate of sodium. It is diuretic, and is very quickly excreted by the urine, which it makes alkaline.

These physiological actions render waters containing bicarbonate of sodium useful for many forms of dyspepsia, for cases in which it is desirable to keep the urine either neutral or alkaline, such as those in which great acidity of it causes vesical spasm, and those of catarrh of the pelvis of the kidney, bladder, or urethra. Often too the attempt is made, and some think successfully, to dissolve small uric acid stones or gravel, or to prevent their formation by rendering the urine alkaline or neutral. These waters are likewise used by those suffering from the various manifestations of gout, and the uric acid diathesis.

The amounts are expressed in grains per pint.

Name.	Situation.	Bicarb. of Sodium.	Chloride of Sodium.
Vals	Ardèche	66	1
Vichy (chiefly summer, but all the year)	Allier	47	5
Bilin	Bohemia	39	3
Fachingen	Nassau	33	6
Salzbrunn	Silesia	23	1
Ems (summer)	Lahn Valley	19	10
Royat (summer and autumn)	Auvergne	13	17
Selters	Nassau	12	22
Roisdorf	Near Bonn	11	18

The greater number of the above have in solution some carbonic acid gas. They are mostly exported from the springs, and patients usually drink them at their own homes, but Royat and Ems are much visited. Vichy water contains three grains of sulphate of sodium to the pint. The temperature of the water at Royat is from 95° to 120° F.

C.—Waters containing Sulphate of Sodium, associated with Bicarbonate of Sodium.

These springs combine the action of their ingredients. Sulphate of sodium is a purgative, increasing both the secretion and the peristalsis of the intestine, and the flow of bile into it.

The waters containing this salt have been found particularly useful in chronic constipation connected with overeating and sedentary habits, also in cirrhosis, fatty liver, mechanical congestion of that organ, and the functional disease usually known as congestion of the liver. Why sulphate of soda is beneficial in these cases, or in those of catarrhal jaundice, and gall stones, in which it often seems to do good, is not exactly known. It is an excellent purgative for sufferers from piles. Obesity is said to be diminished by the use of waters containing it, but it is extremely doubtful whether the drug is capable of accelerating the conversion of fat; most probably it is not, and the cure is due to the altered diet and the free purgation. On the supposition that the liver is the organ primarily at fault, a course of Carlsbad waters is often recommended for those suffering from, or liable to, any of the many manifestations of lithiasis, such as uric acid gravel or calculi, or gout. Carlsbad water is imported into this country; a usual dose is six fluid ounces with an equal part of warm water; the mixture is drunk on rising in the morning, and may with advantage be sipped during dressing. Frequently the sulphate of sodium in it is not sufficient to open the bowels regularly, but the addition of a small quantity of some water containing this salt and sulphate of magnesium will overcome this difficulty. Hunyadi Janos or Æsculap water may, for example, be added; the amount of these required is not the same for everybody, but on the average two or three fluid ounces suffice.

That many sufferers from the above-mentioned conditions are improved in health by going to places where the waters contain sulphate of sodium is certain, but often this is to be attributed to many other circumstances besides the water.

A dose of a natural water containing sulphate of sodium is frequently stated to be more powerfully purgative than the salts in it would be if it were evaporated and they were redissolved in plain water, but this is very difficult of accurate proof, for it is impossible to reproduce precisely the conditions of experiment.

The amounts are expressed in grains per pint.

Name.	Situation.	Sod. Sulph.	Sod. Bicarb.	Sod. Chlor.	Temp. F.
MARIENBAD (summer)	Bohemia ...	48	16	18	50
LEAMINGTON............	England ...	35	—	86	50
FRANZENSBAD (summer)......	Bohemia ...	30	10	10	50
CARLSBAD (all the year, but chiefly summer)					
Mühlbrunnen......	Bohemia ...	25	20	10	125
Sprudel		25	17	10	158
Schlossbrunnen ...		23	16	9	122
TARASP	Engadine...	22	50	35	43
ROHITSCH	Styria	20	10	—	50

D.—Waters Containing Sulphate of Magnesium and Sulphate of Sodium.

These are used almost entirely for their purgative properties, in the same maladies as those of the last group. Most of the springs are rarely visited. Their waters are imported in bottles, and are drunk at the patient's own home. They act best if mixed with warm water and sipped whilst dressing in the morning. An easy movement of the bowels ought to follow after breakfast. The dose varies for different people, but each patient will soon find how much he requires. It is generally somewhere about three fluid ounces. Those who take them often become habituated to them, so that larger doses after a time are wanted; but according to Sir Henry Thompson sometimes the reverse is true, and less and less of the water is necessary each morning. As a rule their action is painless and comfortable, and they are very popular purgatives. Leichtenstern advises that they should not be used by anæmic or weakly people.

The amounts are expressed in grains per pint.

Name.	Situation.	Mag. Sulph.	Sod. Sulph.
Condal	Rubinat, Spain.	28	818
Franz Joseph (Bitterquelle)	Buda Pesth	234	220
Æsculap	Buda Pesth	162	130
Hunyadi Janos	Buda Pesth	150	148
Sedlitz	Bohemia	126	—
Pullna	Bohemia	112	151
Friedrichshall	Saxe Meinengen	51	60
Kissingen (summer) (Bitterquelle)	Bavaria	50	58
Cheltenham (winter)	England		

Epsom waters contain much sulphate of magnesium. They are not now drunk.

E.—Waters Containing Chloride of Sodium as their Chief Ingredient.

These are mostly employed for baths. The waters that are usually drunk do not contain enough chloride of sodium to greatly increase the quantity of salt that is taken daily with the food. The action of chloride of sodium is precisely the same as that of sulphate of sodium, and it may be ordered in cases of indigestion and constipation, but the drinking of it is unpleasant, and it is but rarely used.

It is a most important article of food, and, as mentioned in Chapter VI., before the repeal of the salt-tax, people who were deprived of salt suffered from œdema, general weakness, and anæmia. The symptoms are described as being those of a form of scurvy.

The places whose waters contain chloride of sodium will be enumerated in the chapter on baths.

F.—Waters Containing Iron as their Chief Ingredient.

The diseases for which iron is of service are so well known that it is not necessary to enumerate them. We need only point out the extremely small quantity of iron present in these waters; in most it is so minute that, in all probability, the water is not the most active of the agents which combine to cure the patient. The iron always exists in the form of the bicarbonate, and sometimes other salts of the metal are present as well. There is plenty of carbonic acid gas in nearly all these waters.

The amounts are expressed in grains per pint.

Name.	Situation.	Bicarbon. of Iron.
Muskau	Oberlausitz	5·1 (also 7·5 sulphate of iron.)
Elöpatak	Siebenburgen	2·9
Rippoldsau (summer)	Black Forest	1·2
Renlaigue	Puy de Dôme	1·2
Königswart	Bohemia	1·1
Elster	Saxony	·8
Bocklet	Near Kissingen	·8
Langenschwalbach	Near Wiesbaden	·8
Driburg	Westphalia	·7
Griesbach	Black Forest	·7
Franzensbad (summer)	Bohemia	·7
Pyrmont	Waldeck	·7
Spa (summer)	Belgium	·6
Alexisbad	Hartz	·4
Petersthal (summer)	Black Forest	·4
Cudowa	Silesia	·3
Tunbridge Wells	England	·03

Both Strathpeffer and Harrogate, although chiefly known for their sulphurous waters, have some ferruginous springs.

G.—Sulphur Waters whose Chief Constituent is either Sulphuretted Hydrogen or a Sulphide.

In the chapter on baths it will be shown how little sulphur these waters contain, and that the good resulting from them is to be attributed entirely to their temperature. It is true of these also that any benefits which may be derived whilst drinking them are not due to the sulphur but to the quantity of water drunk, and the various accessories which operate at spas. A list of sulphurous waters will be given in Chapter IX.

H.—The Earthy Mineral Waters containing Bicarbonates of Calcium and Magnesium, and Sulphate of Calcium.

All the trustworthy books on balneology agree that it is impossible to attribute any virtue to the ingredients of these waters. It is in cases of catarrh of the pelvis of the kidney and bladder, gravel and stone, that they are most advocated. Durand-Fardel, Braun, and Leichtenstern concur in saying that the only way in which benefit can accrue is by the diuresis, and the dilution of the urine caused by the drinking of large amounts of water. One of the most popular places at the present time is Contrexéville, where the treatment consists in drinking largely of the water, restricting the diet, and taking plenty of exercise. Many patients have been benefited there; I know a gentleman suffering from uric acid calculi, who improved considerably after a stay of six weeks. All these waters contain carbonic acid gas.

The amounts are expressed in grains per pint.

Name.	Situation.	Bicar. of Ca. & Mg.	Sulph. of Ca.	Other constituents.
DRIBURG	Westphalia	15	10	A little mag. sulph.
CONTREXÉVILLE (summer)	Vosges	13	11	A little nitrogen.
WILDUNGEN......	Waldeck	12	—	A little nitrogen.
LIPPSPRINGE......	Westphalia	6	8	Much nitrogen; a little sulphate of soda.
INSELBAD	Near Paderborn	5	—	Nitrogen, chloride of sodium.
VITTEL (summer) Source salée ...	Vosges	2.5	12·5	A little mag. sulph.
Grande source		2·0	5·5	
LEUK	Switzerland	—	15	Much nitrogen.

Nitrogen arises from the waters at Lippspringe, Leuk, and Inselbad, but there is no evidence that it has more influence than any other moist inhalation.

J.—Waters Containing Lithium.

None of these have enough of the metal in them to be of any importance. The MURQUELLE, which is the strongest, has only half a grain of chloride of lithium to a pint of water.

K.—Waters Containing Arsenic.

Very many springs hold this drug in solution, but in such infinitesimal quantities that it cannot have any medicinal value. The best known powerfully arsenical waters are those of LA BOURBOULE (summer), Puy de Dôme, where there are several springs, and in the strongest of them there is arsenious acid equivalent to $\frac{1}{12}$ of a grain per pint, that is to say the full pharmacopœial dose. At LEVICO, in the southern Tyrol, there are two arsenical springs. The stronger contains about the same amount of arsenious acid as that of La Bourboule, and a considerable quantity of sulphate of iron. In all these waters there are also present minute quantities of chloride of sodium, bicarbonate of sodium, a little free carbonic acid gas, and about as much peroxide of iron as arsenic. They are sold in this country.

Those maladies for which arsenic is serviceable will be improved by drinking, either at the place itself or at home, the waters of La Bourboule or Levico. Such are many chronic skin diseases, especially psoriasis and eczema, several of those forms of anæmia which are not curable by iron, chorea, and chronic rheumatoid arthritis. MONT DORE has very weak arsenical, and also some weak ferruginous and bicarbonate springs. Their temperature is 107—115° F.

L.—Waters Containing Iodine and Bromine.

None of these have enough of either of these elements for them to be of any value whatever. For example one pint of WOODHALL SPA water (all the year) contains—

Free Iodine . .	·025	grains.
Iodine (as Iodates) .	·025	„
Iodine (as Iodides) .	·05	„
Bromine (as Bromides)	·4	„

Any good derived at these springs is to be set down to other circumstances (see page 128) than the water.

The innumerable springs in America have not yet been sufficiently analyzed; but Dr. Peale, of the United States Geological Survey, is at work on the subject. In vol. v. of the *Transactions of the Ninth International Medical Congress* will be found analyses of the mineral and thermal springs of California, which have been reprinted separately. Many of the springs are at places quite unfit for invalids, and are not at present used for medicinal purposes. One in the Coso range of mountains contains 2½ grains of persulphate iron to the pint.

For further information consult the same references as are mentioned in the chapter on "Baths."

CHAPTER IX.

BATHS AND OTHER EXTERNAL APPLICATIONS OF WATER.

It is difficult to give a short account of the various baths and their actions, for often their reputed effects exist only in the minds of those who have an interest in them, and wish to attract as many people as possible. There are few departments of medicine with a larger literature than that of Balneotherapeutics, and probably none contains more rubbish. No account will be given here of the use of cold baths as antipyretic agents, this subject being reserved for another chapter.

When we study the effects upon the human body of a bath, we have to consider firstly its temperature, and secondly its constituents.

I.—THE TEMPERATURE OF THE BATH.

Baths are classified according to their temperature as indifferent, cool, and warm.

Indifferent Baths.

An indifferent bath is one in which a healthy person feels neither hot nor cold. Because water conducts heat better than air, the indifferent temperature of the air, for a naked person, is from 67° to 77° F., but that of water is from 88° to 98° F. Such a bath produces no alteration in the temperature of the body, even if it last for an hour or more. After it there is a pleasant feeling, and there may be a slight loss of heat owing to the evaporation of the water remaining on the body, therefore the bather should always dry himself directly after a bath. There is no change in the excretion of urea or carbonic acid gas, but the amount of urine subsequently passed may be slightly increased. The pulse and respiration are unaltered. It has been stated, but there is no evidence to show, that the skin absorbs water from an indifferent bath. It increases the atmospheric pressure on the body by almost a pound, when the whole body save the head is immersed. We do not know of any effects that can be attributed to this.

Cold Baths.

A cold bath abstracts heat from the body. Liebermeister in 1859, and after him many observers, as for example Jacob, have shown that in spite of this, the temperature in the mouth, axilla, and rectum at first rises slightly; it is unlikely that the diminution of radiation is sufficient to account for this, and therefore the production of heat is in all probability increased. If the bath be very cold, or much prolonged, the increased production probably cannot keep pace with the loss, for there is a fall of temperature. This is greatest on the surface, and least in the interior, and in the folds of the skin. For example, in one of Jacob's experiments the temperature of the skin sank in a cold bath lasting 16 minutes, from 62·6° to 48·2° F., but that of the axilla only sank 1° F. Local withdrawals of heat, such as partial baths and cold douches, have the same effects, but to a less extent. All experimenters are agreed that during a cold bath there is an increased production and exhalation of carbonic acid gas, and that this arises from an excessive decomposition of the non-nitrogenous tissues, which is probably caused reflexly by the stimulation of the nerves of the skin by the cold water. Some consider the increase of carbonic acid gas to be entirely due to this decomposition, but others attribute it in part to the quickening of respiration. It is accompanied by a more rapid production of oxygen, and both continue some time after the bath. If however the cold be excessive there is a diminution in both the production and excretion of carbonic acid gas. Leichtenstern quotes Liebermeister and others to show that there is no excess in the excretion of urea unless the bath be very cold. Braun simply states that the excretion of it is increased, without saying at what temperature this happens.

The rate of the pulse and respiration is at first slightly greater, but soon they both become slower than normal. Thus Draper found that after a bath at 74° F., lasting an hour, they were both slower, and the retardation continued for an hour longer, when the bath was over. The acceleration may be explained by the rise of the blood pressure due to the contraction of the arterioles of the skin, which also causes it to become pale. After a little while the condition of goose-skin is seen. This is probably due to contraction of the *arrectores pili*. The cutaneous sensibility is at first raised, and stimuli which ordinarily could hardly be felt are painful; the bather shivers, feels cold, and very soon becomes numb and anæsthetic, but he has greater power of appreciating the stimuli of warm bodies. If he stop in a long while the bowels and bladder may be emptied reflexly and he may experience partial paralysis of the muscles of the body, together with a general sense of weariness and mental weakness.

After a cold bath of short duration, there is a feeling of exhilaration and warmth, the mental faculties seem cleared, and the muscles to have gained in power. The duration and temperature of a bath necessary to produce these results vary with different people. The common explanation of them is that owing to the contraction of the vessels of the skin, there is more blood in those of the internal organs, which leads to a rapid abstraction of waste products from them, and also to a stimulation of their function, whilst the dilatation of the cutaneous vessels which follows the bath causes the glow and feeling of warmth. If a cold bath does not induce these beneficial results, it may be that either the vessels of the skin have not contracted, or that they have dilated because they are paralysed by the cold, or that, having contracted, they will not expand again on leaving the bath. There are many individual peculiarities in these respects.

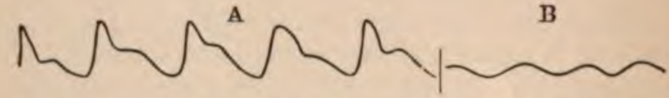

FIG. 3.—Shows the condition of the radial pulse (A) before and (B) after ice poultices were placed on the arm (*Winternitz.*)

Bathers must always be careful not to take a bath so prolonged, or of a temperature so low as to prevent the reactionary dilatation of the cutaneous vessels. A patient feels the after-effects of a cold bath more if he has just had a hot one, and *vice versâ*.

Cold baths are largely used for the exhilaration that ensues, which can be increased by rubbing with a rough towel. If they are taken constantly, the alternate contraction and relaxation of the vessels train them to contract easily, and therefore habitual bathers are not very liable to catch cold. The stimulating property of cold water is used to bring round persons who have fainted, or who are comatose. Ringer recommends its employment in order to arrest attacks of *laryngismus stridulus.*

Locally applied cold causes a diminution in the size of the vessels, of the quantity of blood, a lowering of temperature, in the parts beyond, and the reverse in the parts behind the point of application. Fig. 3, taken from Winternitz, shows the condition of the radial pulse (A) before and (B) after ice poultices were placed on the arm; the temperature of the axilla was raised, that of the palm lowered. Figs. 4 and 5, also from Winternitz, illustrate well the vascular changes produced by heat and cold. They represent respectively the alterations in volume of an arm immersed in water at (Fig. 4) 100·4° F., and (Fig. 5) at 46·4° F., and show that the variations in size are coincident with the pulse, and much greater when the arm is in hot water than when it is in cold.

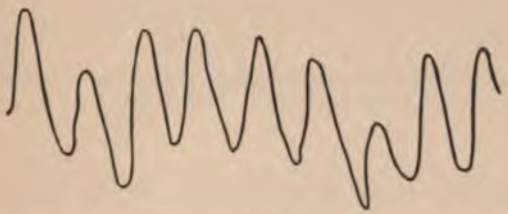

FIG. 4.—Shows the vascular changes produced in an arm by the application of heat (see text). (*Winternitz.*)

The vascular contraction or dilatation produced at one part of the body, by the application of cold or heat respectively, causes the converse condition of the vessels at other parts of the body. This Winternitz has proved with the plethysmograph, by which instrument he obtained a tracing (Fig. 6), that shows markedly the increased volume of the arm due to a sitz bath, at a temperature of 46·4° F. The temperature of the axilla was at the same time raised.

Cold appears to contract not only the vessels of the skin to which it is applied, but also those of the organs under it. Most often this is reflex, but if the intervening tissues are thin it may be due to conduction, and perhaps this explains the utility of an ice bag to the head for concussion. The reflex-action, according to Lauder Brunton, accounts for the fact that a prolonged cold sitz bath, inasmuch as it contracts the pelvic vessels, is useful for diarrhœa. For the same reason a short bath may relieve constipation, because the reaction after it increases the quantity of blood in the pelvic viscera, as is shown by a slight rise in the rectal temperature.

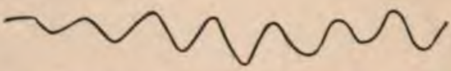

FIG. 5.—Shows the vascular changes produced in an arm by the application of cold (see text, p. 143). (*Winternitz*).

Cold feet are often warmed by the reaction after a cold foot-bath, and menstruation can in some women be checked by the same means. In this case we must suppose that the alterations in the vessels of the lower extremities extend to those of the pelvis.

Cold brought in contact with an inflamed part, by contracting the afferent vessels, diminishes the quantity of blood in it, and thereby relieves the tension, pain, and throbbing. It may be applied in the form of an evaporating lotion, or as an india-rubber ice-bag, such as is put on the head for concussion, or on the knee for synovitis, or by Leiter's coils, which can be employed for almost any part of the body. A long india-rubber bag full of ice is sometimes placed on the spine. This is known by the name of Chapman's spinal ice-bag. Various sounds, catheters, and elastic bags through which cold water can be circulated are occasionally used for the rectum, vagina, and urethra. The application of cold locally, may, in many cases, be conveniently carried out by douches or sprays, which have fantastic names according to the shape of the rose from which the water is ejected. Chronic enlargement of the liver or spleen, various joint diseases, hæmorrhoids, pruritus ani, constipation, and leucorrhœa, are often treated in this way at bathing establishments.

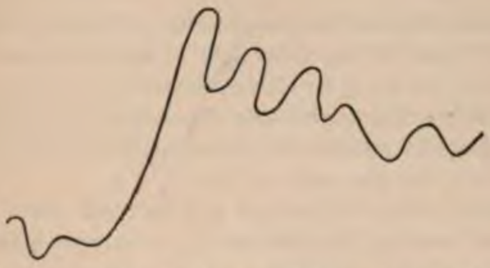

FIG. 6.—Shows the variations in the volume of the arm due to a cold sitz bath. See text, p. 143. (*Winternitz*).

The local baths which have received names are the occipital bath, elbow bath, hand bath, sitz bath, and foot bath.

I have purposely not mentioned all the diseases for which baths and douches have been recommended, for there is no malady that would not be included in such a list, and it would contain many uncouth and unscientific names. If the physiological action of cold and hot baths, local baths and douches be remembered, their application in disease is easy.

Cold baths are contra-indicated in all who do not react rapidly after them. Therefore they should not be ordered for the very young, the very old, or those debilitated by disease, nor for those in whom there is already congestion of any internal organs, unless, as just mentioned, the bath be local. All baths, save those which are temperate, are to be forbidden for persons with disease of the heart.

Warm Baths.

A warm bath raises the temperature of the body by imparting heat to it, and by preventing loss of warmth from it. Zuntz and Röhrig put a dog for eighteen minutes in a bath at 107° F., the animal's temperature rose 4° F., and Seiche and Schmelkes obtained similar results. We do not know whether there is any alteration in the production of heat.

The exhalation of carbonic acid gas and water from the lungs is increased, but because that of oxygen is diminished, the total quantity of respired air is lessened. According to Braun, if a warm bath be very long continued, the blood becomes thick and dark-coloured, and there is a continuance of the greater oxidation at the expense of both the blood and the tissues. At first more, but after a few days less, than the normal amount of urea is excreted.

The pulse and respirations become more frequent, proportionately to the rise of bodily temperature caused by a warm bath. There is a considerable dilatation of the vessels of the skin, which becomes red. This dilatation generally lasts some time after leaving the water, and consequently there is usually a profuse perspiration. Hot water liquefies the fatty secretions of the skin, and is a better solvent than cold, therefore it cleanses the body more thoroughly.

Owing to the dilatation of the cutaneous vessels, blood is withdrawn from the internal organs, and thereby their functional activity is depressed. This explains many uses of hot baths: one taken immediately before going to bed has long been known to be a valuable remedy for insomnia. It has recently been recommended in *The Practitioner* for 1888, by Dr. Eccles. Great weariness of the muscles is relieved by a hot bath, probably because by withdrawing blood from them it lowers the activity of the processes going on in them. Napoleon, always, if possible, took one when he was unable to get a night's rest. Braun lays considerable stress on the chemical changes in the tissues and blood that the rise ot temperature produces, and some authors believe warm baths to have an absorbing power over inflammatory products, but these matters are very difficult of proof.

The effects are often not the same on different individuals, but for nearly all persons the following propositions are true:—

Hot baths, like any other application of heat, soothe pain, hence they are useful for rheumatoid arthritis and colic, whether it be renal, biliary, or intestinal. By bringing blood to the skin, and lessening the amount in the internal organs, they relieve muscular spasm, such as we find in stricture of the urethra, colic, laryngismus stridulus, other forms of laryngeal spasm, and infantile convulsions. In the same way they are of service in weariness from muscular or cerebral activity, are soporific, and are useful in many inflammatory affections, as a cold in the head. The subsequent increased perspiration makes them of great value in the various forms of nephritis, and in uræmia. Great care must be taken after a hot bath, which has been given to induce sweating, to see that the patient is kept warm by being wrapped quickly in a hot blanket, and put into a warm bed. If not, the cutaneous vessels soon contract, all the good of the bath is undone, and there is no diaphoresis.

The local application of a hot bath either in the form of douche, foot bath, or sitz bath, has the same effects but to a less degree. The efficacy of the foot bath is often enhanced by the addition of mustard in the proportion of from one to three ounces to every fifteen gallons of water. The local vascular dilatation caused by a partial hot bath extends to the deep vessels of the part immersed, and even to those of its neighbourhood. A hot sitz bath dilates those of the pelvic viscera, and a hot foot bath—if the lower extremities are deeply covered by the water—expands the branches not only of the femoral but also those of the iliac arteries. Both these, either with or without mustard, may be used for amenorrhœa.

A bath the temperature of which is below 70° F. is commonly called a cold bath, if between 88° and 98° F. it is accurately speaking an indifferent one, popularly this is often called a warm bath, whilst one intermediate between warm and cold is spoken of as tepid. Above 98° it becomes a hot bath; this can be much better borne if its temperature is gradually raised, by which means even 110° may be endured.

This is perhaps the most suitable opportunity for describing the **wet pack.** A bed or couch, easy of access on both sides, and preferably covered with macintosh, is chosen; a large blanket is spread upon it, on this a large sheet wrung out in cold water is placed; the patient is put on the sheet, which is quickly folded all over him except his head and neck, care being taken that contiguous surfaces of skin are separated by the sheet, that it lies smooth over the whole of the body and limbs, and that it is tight round the neck. Several blankets are next wrapped round the patient. At first the cutaneous vessels are contracted, and heat is abstracted by the cold sheet, so that if only applied from five to ten minutes a wet pack is slightly antipyretic. By the end of that time however, the body has heated the sheet to blood heat, and there is profuse perspiration, the heat and sweat are both retained by the blankets, so that neither radiation, conduction, nor evaporation can take place; the body is really in a hot vapour bath, all the cutaneous vessels are dilated, and the pulse and respiration which were originally quickened are slowed. The wet pack, if it last for about half an hour, is valuable as a diaphoretic, and, according to Dr. Eccles, as a powerful sedative to calm an excited mind, and therefore it is useful in those cases of insomnia which are accompanied by much palpitation of the heart and mental excitement. After the pack the patient should be rapidly dried and put into a warm bed.

Dry packing consists in sufficiently wrapping up the body in thoroughly warm blankets or rugs so as to induce sweating. If the patient has previously begun to sweat as the result of exercise, or has expanded all his cutaneous vessels by prolonged immersion in water gradually raised to as great a heat as can be borne, the perspiration in the dry pack will be so profuse that he may lose, according to Liebermeister, as much as four pounds. Dry packing is very valuable for maladies which require a diaphoretic, such as Bright's disease, or a bad cold.

A cold compress is a local wet pack, for it consists of wet lint or rag covered over with some material, as gutta-percha, which prevents evaporation. Over this there may be another piece of lint to keep the whole warm. In a few minutes the vessels of the part to which it is applied become dilated, and its action is precisely that of a poultice; the warmth causes a widening of the collateral vessels near the inflamed part, and consequently the intravascular pressure is reduced and the pain diminished.

Poultices may be made either of linseed meal, bread, bran, oatmeal or starch, with or without the addition of a little mustard. Everything employed in making them should be very hot, and therefore the basin, stirrer and flannel or tow should be put in the oven, and really boiling water used; the linseed or other material added being gradually and constantly stirred; by this means the poultice is much less likely to be lumpy than if the water is added to the meal. If the part it is desired to influence be superficial, such as an abscess just under the skin, the poultice should be applied directly to it, for then the moisture will soak into and soften the inflamed tissues; but if it be deeply seated, the poultice must be wrapped in flannel, or put into a flannel bag, so that having a bad conductor between it and the skin, it can be borne much hotter than if it were in direct contact.

Heat, like cold, applied externally may influence subjacent vessels directly if the intervening tissues are thin, but both agents by reflex action can alter the size of the vessels of deeply placed organs; probably the cutaneous stimulation of warmth, like that of any other counter-irritant, most frequently operates by reflexly contracting the deeper vessels, and this may explain the benefit of a poultice in pulmonary inflammation; it is however not possible to say for certain in which way cold or heat act in any particular case.

II.—THE CONSTITUENTS OF THE BATH.

Formerly the absorption through the skin from a bath of the substances in it and of the water itself was taken for granted, but when quantitative experiments were made it was found to be doubtful whether anything was absorbed. The method of experiment was to weigh the body before and after the bath. Some experimenters found an increase of pounds, others of ounces, others an actual loss of weight; nor are these discrepancies surprising when we remember the various facts they omitted to take into account. Some of these are that it is impossible to dry the skin thoroughly because of its numerous pores and hygrometric hairs; that the drying increases the perspiration, and that some time elapses before the patient can be weighed. The experiments in which the water of the bath was measured are even more unsatisfactory.

The attempt has been made to discover in the urine such substances as were dissolved in the bath. If those experiments in which the bath has had some powerful chemical influence on the skin, those in which the dissolved substance was volatile and might therefore have been absorbed by the lungs, and also those in which the solutions were stronger than they ever are in ordinary baths, are excluded, the results are so contradictory that no reliance can be placed upon them. There may be slightly increased diuresis after a bath, but this is unimportant, because probably it is due to the suppression of perspiration during immersion. No analogy can be drawn from the rubbing of substances into the skin, or from experiments with pieces of dead epidermis. We may therefore say that the absorption of large quantities either of water or of substances dissolved in it does not take place, and that the taking up of small quantities has not yet been proved. Chrzonsczewsky's oft-quoted results which seem to indicate the contrary, are deduced from experiments so fallacious that neither Braun nor Leichtenstern will accept them. Nevertheless it is extremely probable that the skin can to a very slight extent take up substances if they are volatile, and therefore cutaneous absorption may occur in baths which contain them. As they are present in the air over the water they will be inhaled and so absorbed likewise from the respiratory tract. It must be remembered that carbonic acid gas can only be taken up when its tension outside the body is greater than in the blood.

The baths with a gas or salt in solution have a stimulating effect on the skin; it is but mild, and reckons as nothing by the side of the much more powerful influence of the temperature of the water. The superficial layers of the epidermis have the property to a small extent of imbibing fluids; it has been suggested that if these contain salts the terminations of the peripheral nerves may be stimulated by them. Whether or not this be the explanation, a bath having a salt or gas in solution expands or contracts, as the case may be, the peripheral vessels slightly more than a plain bath at the same temperature, and the subsequent vascular changes are more marked. There is no proof that the stimulation caused by the dissolved substances is sufficient to alter in any noteworthy degree the blood pressure, pulse, respiration, urine, tissue metabolism or temperature of the body.

Innumerable electrical attributes have been ascribed to baths, but the only certain facts are that the conductivity of water is increased proportionately to the amount of salts or gases dissolved in it. All waters containing substances in solution act positively when brought in contact with distilled water, and in this respect waters with gas in them are more powerful than those containing a salt. The only exception is that sulphuretted hydrogen baths are negative to distilled water. Heyman and Krebs attach much importance to the stimulating effect of the electricity of baths, but there is no known therapeutical advantage from it.

Durand-Fardel suggests that baths may have a peculiar inexplicable action comparable to that of metallotherapy, but there is no proof of this wild suggestion.

III.—CLASSIFICATION OF BATHS.

Under this heading very little will be said about the diseases for which baths are used, for the previous remarks have shown indirectly the maladies for which they may be employed. Many persons are cured at the various bathing establishments, who would not be if they took similar baths at home, because there they would lack important accessories such as regular meals, rest from work, and bracing air or high altitude which they find at the spas. Only those places will be mentioned which are referred to by the standard authors on the subject; the list is much smaller than it might have been had numerous places which issue pretentious advertisements been included.

A.—Cool Baths not Containing any Important Mineral Ingredients.

These are mostly used for their stimulating properties. Their application is chiefly carried out at hydropathic establishments. The following are some of the conditions benefited by them. General exhaustion from overwork, especially if combined with chronic indigestion—an instance of the good gained by going to a hydropathic establishment is seen in the visits of Darwin to Ilkley and Moor Park. Hypochondriasis and certain cases of hysteria, but with these, and especially the latter, there will be many disappointments. General weakness, particularly that of feeble persons who constantly catch cold, and who require to train the vessels of their skin to contract. Baths must never be so cool as to prevent reaction.

Enough has been previously said concerning the local action of cold. Here we need only add that cold hip baths have been found useful in impotence, spermatorrhœa, certain forms of amenorrhœa and chronic prostatitis. Rheumatoid arthritis is sometimes in mild cases cured by the cold douche.

The chief places[1] famous for their cold bath cures are Ilkley (all the year, chiefly summer), Ben Rhydding, Malvern (all the year, chiefly summer), and Matlock (all the year, chiefly summer) in England. Wemyss Bay (summer), Forres (summer), Crieff (summer), in Scotland. Nassau (summer) near Ems, Boppard (summer) on the Rhine, Godesberg (summer) near Bonn, Wiesbaden (hot baths also), Alexandersbad on the Fichtelgebirge, Liebenstein in the Thuringian forest, in Germany, and Rigi Kaltbad (summer) in Switzerland.

B.—Warm Baths not Containing any Important Mineral Constituent (*Indifferent Thermal Waters or Wildbäder*).

These are chiefly of service for chronic rheumatoid arthritis. It is also stated that the absorption of the products of many chronic inflammations is accelerated by a warm bath. For this reason it is used for pelvic cellulitis, cicatrices and swellings that remain after dislocations, fractures, gunshot wounds, &c., chronic cutaneous ulcers and old syphilitic exudations. Warmth also aids other treatment in gout, because it soothes pain and facilitates the absorption of the products of inflammation around the joint. It is not only an anodyne, but allays irritation, therefore tepid baths relieve the itching of prurigo, the tingling of erythema, and the pain of neuralgia and sciatica. Certain skin diseases in which there is a large accumulation of scales, as psoriasis, very chronic eczema, and exfoliative dermatitis, are improved by warm baths. For these maladies Hebra so arranges a bath that a patient can remain in it for days at a time without getting out even to relieve the bowels or bladder. The water is pleasantly warm, and kept at a constant temperature. The following is a list of the more important warm waters.

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[1] In this and other lists the season is put in brackets immediately after the name. The temperature is expressed in degrees Fahrenheit, and the elevation in feet.

Name.	Situation.	Temperature.	Elevation.
Aix-les-Bains (all the year, chiefly summer)	Savoy	90—114	650
Badenweiler (all the year, chiefly summer)	Black Forest	79	1425
Baden	Switzerland	114—120	1250
Bath	England	107—117	100
Bormio (chiefly summer)	North Italy	95—104	4300
Brussa	Turkey	55—170	
Buxton	England	82	1000
Dax (all the year)	Landes, France	116—140	120
Gastein	Austrian Alps	95—138	3315
Hammam-Mescoutin (spring and autumn)	Algeria	115—203	
[1] Hammam R'Hira (spring and autumn)	Algeria	107—110	1900
Johannisbad	Bohemia	84	2000
Leukerbad	Canton Vallais	102—124	4670
Néris	Allier, France	118—125	820
Neuhaus	Styria	95	1200
Pistyán	Hungary	86—104	
Plombières (summer)	Vosges	66—158	1310
Pfaffers	Canton St Gall	104	2130
Ponte Seraglio	North Italy	100—129	
Ragatz	Canton St. Gall	96	1570
Römerbad (summer)	Styria	93—99	755
Schlangenbad	Taunus	80—89	900
Teplitz (all the year, chiefly summer)	Bohemia	105—118	648
Warmbrunn	Silesia	96—107	1100
Wildbad (all the year, chiefly summer)	Black Forest	93—102	1330

Among the above, Bath, Leuk, and Ponte Seraglio contain some sulphate of lime, but that does not in any way alter their action as warm mineral springs.

C.—Baths Containing as their Chief Ingredient Common Salt (Soolbäder).

A medium strength for a salt bath is 2 or 3 per cent., that is to say, 18-27 pounds of salt to 100 gallons of water. We have already shown that the only known effect of bathing in water in which salts are dissolved is that the skin is stimulated to a slight degree more than it would be by plain water baths at the same temperature, but the difference is so slight that the value of salt baths depends almost entirely upon whether they are cool, warm, or indifferent.

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[1] *Lancet*, June 9, 1888.

The diseases for which they are applicable have therefore been already indicated. The iodine and bromine that exist in some are in too small a quantity to have any influence. The water is often diluted or evaporated, or more salt is added to it, usually in a very concentrated solution called mother lye, either from the same or another spring; by these means the percentage composition of the bath is altered.

(*a*) WEAK COLD SALT BATHS

(containing under 1·5 per cent. of chloride of sodium, which is expressed in parts by weight in a 1,000 parts of water).

Name.	Situation.	Sod. Chl.	Other important constituents.	Elevation.
CANNSTADT	Near Stuttgart	2·0	CO_2	600
HALL	Austria	12·0	CO_2. I & Br. salts.	1064
HARROGATE (all the year)	Yorkshire	12·0	Sulphuretted hydrogen & sulphides	450
HEILBRONN (Adelheidsquelle)	Bavaria	5·0	CO_2. I & Br. salts.	2400
HOMBURG (Elizabethbrunnen)	Near Frankfort	9·8	CO_2.	600
IWONICZ	Galicia	8·0	CO_2 I & Br. salts.	
KISSINGEN (summer)	Bavaria	5—11	CO_2.	590
KREUZNACH (chiefly summer)	Nahe Valley	9—14	Br. salts.	286
SODEN	Nassau	4—14	CO_2.	440
WIESBADEN (Faulbrunnen)	Nassau	3·4		323
WOODHALL (chiefly summer)	Lincolnshire	17·0	I & Br. salts.	Slight.

(*b*) WEAK WARM SALT BATHS.

Name.	Situation.	Sod. Chlor.	Other ingredients.	Temp.	Altitude.
BADEN-BADEN (all the year, chiefly summer)	Baden	2·0		111—154	616
BOURBONNE LES BAINS	Marne	5·8		136—180	900
BRIDES LES BAINS	Savoy		CO_2	95	1800
MONDORF	Luxemburg	8·7		77	600
SALIN-MOUTIERS	Savoy		Iron & arsenic.	96	
WIESBADEN	Nassau	5—7	CO_2.	120—150	323

(*c*) STRONG COLD SALT BATHS.

These are not much used. The following are some of them. The quantity of chloride of sodium is expressed in parts by weight in a 1,000 parts of water.

Name.	Situation.	Chloride of Sodium.
ARNSTADT	Thuringia	224
AUSSEE (summer)	Styria	244
BEX	Canton Vaud	156
DROITWICH	Worcester	850
FRANKENHAUSEN	Thuringia	248
HALL	Tyrol	255
ISCHL	Salzkammergut	255
REICHENHALL	South Bavaria	224
RHEINFELDEN	Aargau	311
SALZUNGEN	South Meiningen	256

(*d*) STRONG WARM SALT BATHS.

These also are rarely used. The chloride of sodium is expressed in parts by weight in a 1,000 parts of water.

Name.	Situation.	Sod. Chlor.	Other constituents.	Temp.
REHNE OEYNHAUSEN	Weser	24—85	CO_2.	80—90·7
NAUHEIM	Hesse Nassau	29	CO_2.	95

D.—Sea Water Baths.

The results produced by these are due to the stimulating effect of (1) their cool temperature, (2) their salts, (3) their movement, and (4) the pure moist air of uniform temperature. The first three of these have already been considered in this chapter, and the last will be found discussed in Chapter I. The value of sea baths is beyond all doubt, but as a rule they are serviceable not so much for persons who have definite diseases, because with them the exposure to the air and the low temperature prevent a healthy reaction, as for the numerous patients who suffer from weakness and mal-nutrition—cases that many would call mild examples of scrofula. It is quite unnecessary to name the various seaside bathing stations.

The composition of sea water in various parts of the world is as follows, the quantity of salts being expressed in parts by weight in a 1,000.

Dead Sea	227·69.
Mediterranean at Marseilles	40·7.
South Atlantic	36·4.
North Atlantic	35·97.
Pacific	33·5—35.
Indian Ocean	33·86.
English Channel	32·35.
German Ocean	29·
Black Sea	15·9.
Baltic	5—9.

The mean summer temperatures of the sea are :—

Mediterranean	71·6—80·6.
Atlantic (European)	68—73·4.
German Ocean	60·8—64·4.
Baltic Sea	59—62·6.

The following table of the composition of ocean water shows that chloride of sodium is the only important constituent.

Chloride of Sodium	25·1.
Chloride of Potassium	·5.
Chloride of Magnesium	3·5.
Sulphate of Magnesium	5·78.
Sulphate of Lime	·15.
Carbonate of Magnesium	·18.
Carbonate of Lime	·02.
Carbonate of Potassium	·23.
Iodides and Bromides	Traces.
Organic matter	Traces.
Water	964·54.
	1000·00

E.—Sulphur Baths.

In olden days marvellous cures were ascribed to these. Now we know that in all the sulphur springs the sulphuretted hydrogen, which is the most constant constituent, or the other compounds of sulphur (usually sulphide of sodium) which may be present, exist in such infinitesimal quantities that no action can be attributed to them. The good that patients obtain by bathing at such spas is nearly always to be set down to the temperature of the water. Therefore the conditions suitable for these baths have already been considered. In a few there is a little carbonic acid gas or chloride of sodium.

(*a*) Warm Sulphur Baths.

Name.	Situation.	Temp.	Elevation.	Other constituents than Hydrogen or Sodium Sulphide.
Aachen or Aix-la-Chapelle …………	Rhenish Prussia …	97—110	590	NaCl & CO_2.
Aix les Bains………	Savoy ……	112–114	800	
Amelie les Bains…	Pyrenees …	142	750	
Baden …………………	Switzerland	115	1250	CO_2 & Sod. Sulphate.
Baden bei Wien……	Austria……	92	700	
Barèges ………………	Pyrenees …	111	4000	
Barèges de Luchon	Pyrenees …	154	1000	
Burtshied……………	Rhenish Prussia …	119—137	3100	NaCl & CO_2.
Cauterets …………	Pyrenees …	102	3180	
Eaux Bonnes ………	Pyrenees …	90	2400	
Herculesbad ………	Hungary …	112		
Pistyan ………………	Hungary …	173		CO_2.

(*b*) Cold Sulphur Baths.

These are of much less importance.

Name.	Situation.
Eilsen ……………………………………	Germany.
Harrogate…………………………	Yorkshire.
Lisdunvarna ………………………	Ireland.
Meinberg …………………………	Germany.
Moffat ……………………………	Dumfries.
Nenndorf ……………………… …	Germany.
Strathpeffer ………… ………	Ross-shire.
Weilbach ……… . ………………	Germany.

Harrogate contains very strong sulphur springs. Strathpeffer has an effervescing chalybeate water. Both these places and Moffat have excellent accommodation and are much patronized by those seeking a holiday and rest.

F.—Carbonic Acid Gas Baths.

These have no effect on the exterior of the body save that of slight stimulation. In the previous lists mention has been made of springs containing this gas. Those in which it is the principal ingredient are chiefly used as drinking waters, and have been described in Chapter VIII. If they are heated, much of their gas is driven off.

G.—Iron Baths.

No natural water contains enough iron for these to be of any importance.

For further information consult :—

(1) Braun. *Lehrbuch der Balneotherapie.* *5th Edit., Berlin.* *Edited by Fromm.*
(2) Leichtenstern. *General Balneotherapeutics*, vol. iv. Ziemssen's *Handbook of General Therapeutics.* *Eng. Trans., London*, 1885-86.
(3) Winternitz. *Hydrotherapeutics*, vol. v. Ziemssen's *Handbook of General Therapeutics.* *Eng. Trans., London*, 1885-86.
(4) Helfft. *Handbuch der Balneotherapie.* *9th Edit.* *Edited by Thilenius. Berlin*, 1882.
(5) Durand-Fardel. *Traité des Eaux Minerales.* *3rd Edit., Paris*, 1883.
(6) Macpherson. *Our Baths and Wells.* *3rd Edit., London*, 1888.

For an elaborate analysis of all the springs see Friedrich Raspe. *Heilquellen-analysen für normale Verhältnisse, und zur Mineralwasserfabrikation berechnet auf zehntausend Theile.* *Dresden*, 1885.

CHAPTER X.

COLD WATER AS AN ANTIPYRETIC.

ALTHOUGH in ancient times cold water was occasionally recommended for fevers, the credit of having established the treatment of them by it belongs to James Currie, of Liverpool, who in 1797 published the first edition of his *Medical Reports on the Effects of Water, Cold and Warm, as a Remedy in Fever and other Diseases, whether applied to the Surface of the Body or used Internally.* This book reached its fourth edition in 1805. The author states that he tried the treatment because he had seen how Dr. William Wright, who afterwards became President of the College of Physicians of Edinburgh, when suffering from fever on board ship, went on deck and had three buckets of cold salt water thrown upon him to his immediate relief. The great merit of Currie's work over that of his predecessors is that he took the temperature of his patients. He used the cold affusion. Giannini in 1805 first published an account of the employment of cold baths for fevers. The method was much practised for some time, but then fell into disuse. Brand in 1861 described his experience of cold water in fever, but we are indebted to Niemeyer, Jürgensen, Ziemssen and Liebermeister for having reintroduced it, and put its application on a scientific basis.

A rise of temperature of the body may be due to an increased production of heat, a decreased loss of heat, or a disturbance of the thermotaxic mechanism which normally maintains the balance between the two.

The production takes place chiefly in the muscles, which have two functions, motor and thermogenetic. Macalister (*The Nature of Fever*, 1887) has shown that these are distinct, and also what is of great importance, that an extreme degree of cold lessens the capability of the muscle to produce heat much more than it affects its motor power. This conclusion is probably not applicable to a healthy individual taking an ordinary cold bath, for owing to the contraction of the cutaneous vessels, the blood and consequently the muscles are but slightly cooled. In such a bath, according to the researches of Frédéricq and Quinquand (quoted by Dujardin-Beaumetz, *Therapeutic Gazette*, Feb. 1888), the absorption of oxygen, elimination of carbonic acid gas, and thermogenesis are increased. In spite of these changes the rectal temperature falls, so that the abstraction of heat must be very great. The greater thermogenesis is most probably due to the stimulation of the skin, which reflexly affects those nerves presiding over heat production. If, however, the bath be still colder, the absorption of oxygen and excretion of carbonic acid gas, which may be taken as indications of the amount of thermogenesis, fall below the normal point, thus really confirming Macalister's statements. The substance in the muscle which when metabolized produces heat he proposes to call thermogen.

The cutaneous vaso-motor system, and the sudoriferous glands are the chief means of loss of heat. Both of these, and also the heat-productive mechanism, which is probably controlled by the nervous tissues in the neighbourhood of the corpus striatum, are under the influence of the nervous system. The thermotaxic mechanism must also be nervous.

Returning to the employment of cold for fever, we see at once that the possible modes of action of any antipyretic agent are very numerous. We can however safely affirm that the external application of cold acts by direct abstraction of heat, and probably also, after a short time, by diminishing thermogenesis, especially if the cutaneous vessels are much dilated, as they often are in fever, for then a great quantity of cool blood is quickly carried to the muscles. At first the rectal temperature rises a little, either because the body endeavours to compensate for the direct abstraction by greater thermogenesis, or because there is an increased retention of heat owing to the diminished radiation that follows the contraction of the cutaneous vessels, which must take place to a certain extent, or again both causes may operate: but soon the temperature falls, and continues to descend even after the patient is taken out of the bath. This subsequent sinking may be due either to the continued cooling of the blood which flows from the skin to the interior, or to a persistence of the lessened thermogenesis, or to both these causes.

The precise structures of the body on which any mode of antipyresis acts have not yet been discovered.

It has often been maintained of late that febrile pyrexia is beneficial, for it is thought to destroy the micro-organisms which are supposed to give rise to the fever; and the deduction is drawn that by reducing it we really harm the patient. The ardent defenders of antipyretic modes of treatment, on the other hand, argue that not only is pyrexia pernicious in itself, but also that most of the febrile symptoms are directly due to it, and that the temperature ought for both these reasons to be kept low; many however admit that we do not know whether this is the origin of these symptoms, for it is quite possible that they and the pyrexia result from the same, or even different, causes. In favour of this it may be said that sometimes febrile symptoms are present without any rise of temperature; thus the delirium of rheumatic hyperpyrexia often precedes the pyrexia, and I have seen a patient suffering from acute delirious mania with a flushed face and every symptom of fever save the temperature. Some of the advocates of the antipyretic method leave the position they originally took up, and state that the treatment by cold baths has the beneficial effect not only of reducing the temperature but also of ameliorating the other symptoms of fever even if they are not due to it. Our knowledge is altogether too imperfect to enable us to settle the question by *à priori* reasoning; hence in this controversy theoretical argument must always ultimately be given up, and appeal be made to statistics showing the results of treatment.

Cold baths as an antipyretic have been chiefly used in typhoid fever. Jürgensen (*Pathologie und Therapie*, 1886) gives as the reason that typhoid, of all fevers, is the one in which danger threatens most from pyrexia. He defends the antipyretic method, and compares the expectant method, which is founded on the theory that the temperature is beneficial to the patient because it destroys the germs which cause the disease, to ridding a house of vermin by burning it down.

There are many ways of employing cold water to reduce febrile temperature. They are as follows:—

The Cold Bath.—This is undoubtedly the most efficacious. It is best applied by means of a long bath placed at the end of the bed, so that both are in the same straight line. The patient with a blanket over him is lifted in a sheet, and by it lowered into the water, and the blanket, the only object of which is decency, remains over the top of the bath. In lifting him out the hands are passed under him, and the wet sheet is left behind; he is put back into bed, and a sheet or single blanket is thrown lightly over him. The temperature of the bath should be between 58° and 68° F., or warmer if that of the patient be high. The point of fever heat at which he should be bathed varies with the disease, and will be considered presently. The immersion should last about ten minutes, for the quantity of heat which at the end of this time can be further abstracted is but small, as the rapidity with which heat is given from a hot body to a cold one increases with the difference of temperature between the two. Hence short bathings frequently repeated are much more potent than a single long one. The temperature of the bath may be higher with children, for they present a much greater proportional surface from which to withdraw heat. In private practice there is sometimes much inconvenience in arranging the bath. This difficulty may be surmounted by raising the head of the bedstead a few inches, making thereby an inclined plane of it. Under the patient a large mackintosh sheet is placed, and is extended over a bank of pillows on either side, a gutter is made in the mackintosh at the foot of the bed so that cold water poured in at the head will run out at the foot, where it is caught in some suitable vessel. The pillows at the side may be so high that the patient lies in a bath of running water.

The Tepid Bath Gradually Cooled.—This, first employed by Ziemssen, is applied thus: The patient is put into a bath the temperature of which is from 9° to 10° F. below that of his body. Cold water is then gradually poured in, till after ten or fifteen minutes the temperature of the bath has fallen to about 68° F. He remains in from twenty to thirty minutes, when generally severe shivering or chattering of the teeth begins. He is then quickly moved back to a bed which has been previously warmed. This method is not nearly so good as the cold bath, and is more difficult to carry out; nevertheless it has two great advantages, namely that it is more comfortable to the patient, and that it can be used in cases in which, from the condition of the heart, there is any likelihood that the shock of the cold water may be too severe.

The Cold Affusion.—This is the method Currie used, for he threw cold sea water over those whom he treated. The patient should be placed in an empty bath, and water at about 60° F. thrown over him ; this is done for about five minutes. The cold affusion is now but rarely used, for the reduction of temperature caused by it is slight, and the shock is so great as to be extremely disagreeable. It is absolutely forbidden when there is any sign of cardiac mischief. Possibly some of Currie's good results may be set down to the fact that he used salt water, which is more stimulating than fresh, and perhaps it would be advantageous to put salt into the cold and tepid baths.

The Cold Pack.—The naked patient is wrapped in a sheet four folds thick, which has been wrung out in cold water, and is carefully placed between the thighs and in the axillæ. It is often recommended that the sheet should not reach quite to the feet because of the difficulty of folding it over them. Outside it a blanket is thrown. In five or ten minutes the patient is removed from between the folds of the sheet, and a fresh one is substituted. This is more easy if there are two beds. The process is repeated four to eight times, and even then is not so powerful as a cold bath.

Sometimes simply sponging with cold water, or a large ice poultice is used, but the reduction of temperature that can be obtained by these methods is uncertain and slight.

Ziemssen and Immerman give the proportionate efficacy of the cold affusion, a series of four cold packings, the gradually cooled bath and the cold bath as 1 : 2 : 3 : 4.

Cold baths administered to febrile patients in the latter part of the evening and in the night cause a more durable and greater reduction of the temperature than those given in the daytime, and the reduction produced by a nocturnal cold bath, is greater than would be the difference between the night and day temperatures in the same case if it had not been treated by a cold bath. This is due no doubt, in part at least, to the fact that at night the temperature is naturally falling, and that it is easier to reduce a falling temperature than a rising one. We thus learn that baths ought to be continued through the night. Currie knew this, for he says: "The safest and most advantageous time for using the aspersion or affusion of cold water is when the exacerbation is at its height, or immediately after its declination is begun. And this has led me almost always to direct it to be employed from six to nine in the evening."

We will now consider the use of cold baths in various fevers.

Typhoid Fever.

This is the disease for which the cold bath has been most energetically used, and all authors concur that with it the mortality is much less than with any of the previous methods of treatment. In England Dr. Cayley has advocated it in his Lumleian Lectures, it has been discussed at the Medical Society, and at the meeting of the British Medical Association, and on each occasion the principal speakers were strongly in favour of it. Some theoretical considerations are opposed to it, and therefore its whole value rests on experience.

According to Murchison, the death-rate of typhoid fever from the years 1848-1870 for France, Germany, and England was 4,723 out of a total of 27,051 cases, or 17·45 per cent. Jaccoud has collected 80,149 cases occurring between the years 1840 and 1881; among them the mortality was 19·23. Brand has got together 8,141 cases treated more or less regularly by cold baths, of which 600 died, or 7·4 per cent; but the mortality among those treated consistently from the first was only 6 per cent. Numerous statistics have been published, which seem to prove that the results of the cold bath treatment are very much better than any which were obtained before its introduction. There are many fallacies in limited statistics, but in these such large numbers are taken, and the difference is so striking, that there can be no doubt as to the interpretation. Figures showing the mortality under this or any other treatment do not present it in so favourable a light as it deserves, for deaths are included which nothing could have averted.

The fairest comparison is between cases from the same hospital before and after the introduction of the cold bath. Quinine, it should be mentioned, is sometimes also used, but an examination of the figures shows that the use of this drug is not sufficiently constant for its effects to have much influence on the conclusions.

Liebermeister's statistics state that at Bâle, from 1854 to 1864, the mortality on the expectant symptomatic treatment was 18·1 per cent. among 1,847 patients. Almost the same number treated on antipyretic principles gave a death rate of 7·2 per cent. Eliminating the slighter cases we get—(1) under expectant symptomatic treatment a mortality of 27·3 per cent.; (2) under imperfect antipyretic treatment 21·3 per cent.; (3) under thorough antipyretic or cold bath treatment 11·2 per cent. MM. Tripier and Bouveret give the following figures from the Hospital de la Croix Rousse:—(1) From 1866-1872 among 229 cases treated on the expectant method, the mortality was 26·2 per cent. (2) From 1873-1881 among 626 cases treated imperfectly by cold baths the mortality was 16·9 per cent. (3) From 1882-1885 among 260 cases treated thoroughly by the cold bath the mortality was 7·3 per cent. Some even more striking figures have been published. In the military hospital of Stettin, before the introduction of cold baths, the mortality was 26·3 per cent., but afterwards it fell to 1·6. At the hospital at Stralsund the death-rate under the method of tepid baths gradually cooled was 10 per cent., and with cold baths it was 0·6 per cent.

Most authors affirm that a cold bath should be given whenever the axillary temperature reaches 102·2° F., but others fix the point at 103° F. All agree in saying that, to obtain the best result, bathing must be adopted from the beginning of the illness. Fewer cases come under observation late than early, yet among twenty patients whose deaths are recorded by Tripier and Bouveret, in seven the treatment had been begun after the twentieth day, in ten between the eighth and sixteenth days, and in three only during the first week. It is impossible to say whether an attack of typhoid fever will turn out to be severe, therefore it is advisable to adopt the antipyretic treatment early, even if the case appear to be mild.

Complications are rare if the cold bath has been employed from the beginning, but common if not used till later. Among 355 cases recorded by Brand, they only occurred in those in whom the treatment was commenced after the seventh day. When this method was introduced it was argued from *à priori* considerations that the number of cases with pulmonary complications would be greater, but experience teaches us that the liability to bronchitis, pneumonia and broncho-pneumonia, is much diminished. The following table compiled by Hoffman and Liebermeister shows this :—

Among a large number of patients with typhoid fever	Under ordinary treatment.	Under cold bath treatment.
	Per cent.	Per cent.
Severe affections of the lung were present in	20	7·7
The mortality from severe affections of the lung was......	7·7	2·1
Among patients suffering from these affections there died..	50	35·7

Probably the frequency of the rarer sequelæ such as abscesses is likewise decreased.

Epistaxis, pleurisy, and albuminuria are not contra-indications although some authors have regarded them in this light, neither is an ordinary bedsore; but Tripier and Bouveret consider that cold baths are undesirable if the bedsores are extensive, chiefly because it is impossible to keep the wound properly dressed.

Perforation of the intestine and peritonitis are absolute contra-indications to the cold bath; so is severe intestinal hæmorrhage, but if the bleeding is only slight no harm follows bathing. Should the patient have any laryngeal complication, especially if it impede the entrance of air, cold baths should not be given, for they may bring on suffocative attacks. Pericarditis or any malady rendering the patient liable to syncope, should make the physician cautious, and, as a rule, he ought in any case of this kind to forbid baths.

If the patient be very collapsed when first seen, a tepid bath must be given instead of a cold one.

Many conditions, which are not complications, for they are independent of the typhoid fever, have been erroneously regarded as contra-indications. Such are pregnancy, menstruation, suckling, phthisis, and mild chronic bronchitis. Obesity and old age need not, in themselves, prevent cold bathing.

If there is any reason to fear that the heart is not healthy enough to withstand the shock of the cold bath, it must not be used. The only modifications then permissible are the gradually cooled bath, or cold sponging, and either ought to be employed with care. Patients with typhoid fever, who also suffer from severe emphysema must be treated in the same way. Those who have previously drunk too much alcohol offer a feeble resistance to typhoid fever, and therefore with them it is specially imperative to begin cold bathing early.

The cold bath does more than reduce the temperature. The patient on being put in it, at first experiences a sensation of discomfort from contact with the cold; there is a feeling of want of breath, and the respirations are few, gasping and deep. All this soon passes off, and he often enjoys the bath. At any time during the immersion shivering may set in, but this should not be taken as an indication for immediately removing him. It usually appears earliest in those who are thin; once present, it gradually gets more severe, and the patient should be taken out before it becomes violent. As a result of the contraction of the cutaneous vessels, the pulse is hard, and sometimes so small that it can only be felt with difficulty (Figs. 7 and 8); this often makes inexperienced physicians think that the patient's state is serious, and he is removed before it is necessary. The pulse is at first slightly accelerated but soon it is retarded; and if dicrotic, loses its dicrotism; the skin becomes pale, and shows the condition of "goose" skin. The delirium, tremor, prostration, involuntary passage of urine and fæces, and other symptoms which make up the typhoid condition are most markedly diminished. For instance, not only does the delirium come on much more rarely, but the delirious patient is very often restored to consciousness by the bath. No one can fail to be struck by the different appearance of sufferers from typhoid fever treated by the cold bath, and those treated on the expectant plan. The latter, if severely ill, are prostrate and unconscious; the former are brighter, conscious, and comfortable. Because

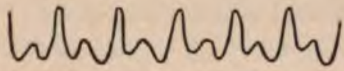

FIG. 7.—Pulse tracing of a patient with typhoid fever before a cold bath (*Tripier and Bouveret*).

all the typhoid symptoms are improved by the cold bath, many have concluded that they are due to the temperature. This does not necessarily follow; and it is impossible to give an opinion worth anything till we know more of the pathology of fever. Cerebral symptoms, such as delirium, or intense headache, even if unaccompanied by the typhoid condition, are improved by the bath. The dyspepsia, of which those who have typhoid fever so often complain, and the diarrhœa, are both said to be lessened. The scanty, deeply-coloured urine, with a high specific gravity, becomes more abundant, pale, clear, and of a lower density. We do not know whether the rose spots are in any way influenced. Tripier and Bouveret, after going over the various observations that have been published on the subject, conclude that the loss of weight during the fever is less, and its gain afterwards more rapid in patients treated by the cold bath than in those treated on expectant principles. Which system leads to the greater elimination of carbonic acid gas is disputed. There is still some doubt about the influence of cold baths upon the excretion of urea, but most likely they diminish it. It is extremely probable that tissue metamorphosis is retarded, although the rise of temperature in the rectum at the beginning of the bath may perhaps mean that at first it is increased, but if so, this is more than compensated for by the subsequent retardation, and the direct abstraction of heat. It will be noticed that this view is in harmony with our knowledge of the action of cold upon the healthy body.

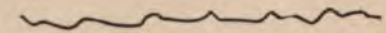

FIG. 8.—Pulse tracing of same patient half-an-hour after bath (*Tripier and Bouveret*).

None of these modes of the application of cold shorten the fever. Relapses are slightly less rare among those who have had baths regularly than among those who have not. The reason suggested is that relapses are always more common in slight cases, but it is not known if this be true. The greater frequency of them is not sufficient to prevent us from using baths.

Patients feel so much more comfortable after them, that usually when they have had one they are only too glad to have others. I remember a man who for weeks had a very great number, but always looked forward with pleasure to the next.

It is quite possible observation may ultimately show that cold baths do not give such good results as some of the recently introduced antipyretic drugs. Antifebrin especially is at present very largely employed, almost to the exclusion of cold water. A sufficient number of cases will soon have been treated by it for us to judge of the comparative value of the two treatments. As far as my experience goes the drug is superior, for it is as efficacious and does not necessitate the trouble of bathing.

Any disease accompanied by pyrexia may be treated by the external application of cold water, and much of what has been said concerning typhoid applies to other febrile disorders. We will briefly mention the principal ones in which this treatment has been used.

Typhus.

It was for this malady amongst others that Currie employed the cold affusion. The third chapter in his book is an account of an outbreak of typhus in a regiment stationed in Liverpool in 1792. Cold sea water of a temperature of about 60° F. was poured "over the naked bodies of those whose strength was not greatly reduced and whose heat was steadily above the temperature in health." He attained great success in this disease, as have many who have used cold water in one way or another since his time. Jürgensen recommends it in his *Pathologie und Therapie* (1886), and Brand gives an account of it.

Scarlet Fever.

The duration of the pyrexia is not long enough to make it often necessary to use the cold bath. Currie's description of the manner in which he threw cold water over his own children who suffered from scarlet fever, is so graphic that I may be excused if I quote again from him:—"I shut myself up with these boys; and with plenty of pump water and a pocket thermometer prepared not without anxiety to combat this formidable disease. As soon as the sensation (of heat) was steady in my eldest boy, I stripped him and poured four gallons of water over him of the temperature of 64. The usual good effects immediately appeared, but at the end of two hours he was as hot as ever—the remedy was again applied, and repeated as the return of heat indicated. By the time the eldest was ready for his third affusion, the youngest was ready for his first. The heat rose in the eldest to 109, in the youngest to 108, and the pulse in each was upwards of 150. In thirty-two hours the first had had the affusion fourteen times, eight times cold, twice cool, and four times tepid. Twelve affusions sufficed in the case of the youngest, of which seven were cold. The fever in both was completely subdued. On the morning of the third day they were both evidently safe."

Small Pox.

Currie and others have used cold water for this disease, but it is not often required. Dujardin-Beaumetz, and several writers are strong in their advocacy of warm baths (70-77° F.) during the period of suppuration, for they keep the skin clean and sweet. For the period of desiccation tepid baths are advocated.

Measles, Pleurisy, Meningitis, and Erysipelas.

The method has been recommended in each of these, but the cases demanding it are few.

Miliary Fever or Sweating Sickness.

In some epidemics of this disorder the cold bath has been employed.

Pneumonia.

In Germany it has of late years become customary to treat lobar pneumonia in this way. Liebermeister states that by it the mortality in the hospital at Bâle has been reduced from 25·3 to 16·3 per cent. Fismer contrasts 230 cases treated before the introduction of the cold bath with the same number treated by it, and finds the deaths to be 60 in the first series against 38 in the second. He fixes the temperature of the patient at which the bath should be given at 102·2° F. It does not appear that the disease is curtailed by it. In England it is seldom used, although some physicians treat their cases with cold sponging or ice applied to the wall of the chest. Just at present antipyretic drugs are more popular than cold baths with those who attack the pyrexia of this disease.

Rheumatic Fever.

For the ordinary cases of rheumatic fever treatment by cold water is not required, as we have such a powerful agent in salicylic acid, but in rheumatic hyperpyrexia cold baths must be energetically and frequently repeated even after all hope seems lost. There have been some striking cases at Guy's

Hospital, and there are several scattered through the *Transactions* of the Clinical Society, who appointed a committee to report on the subject. The following are the more noteworthy conclusions at which they arrived :—

Of the cases that were not bathed only one in which the maximum temperature exceeded 106 recovered : of the cases that were bathed fifteen (or five-eighths of the total) in which the maximum exceeded 106 recovered. Again, in six out of eleven fatal cases which were not bathed, the maximum was under 106, but in only three out of the twenty-two fatal bathed cases was it so low. Often the treatment is of no avail, but, on the other hand, it frequently turns the scale towards recovery when the temperature has not reached an extreme height. In a considerable number of the deaths recourse to bathing has been too tardy to be effectual. The treatment must be begun without any delay whatever, directly hyperpyrexia, however slight, is detected, and must be persevered in unremittingly so long as the temperature remains high. The committee truly say that a strict watch must be kept for the prodromal signs. Two which are most noteworthy are delirium and a cessation of the articular pain. Cold bathing not only reduces the temperature, but also allays the delirium, brings down the frequency and increases the strength of the pulse, and promotes sleep even in the most desperate cases. If it were made a rule to put the patient in a cold bath whenever the temperature reaches 105, the mortality in rheumatic hyperpyrexia would greatly fall. Cases occur in groups, thus it was comparatively frequent in the Middlesex Hospital from 1874-1876, both inclusive.

For further information consult :—

(1) Liebermeister. *Antipyretics.* Von Ziemssen's *Handbook of General Therapeutics*, vol. ii. *Eng. Trans. London*, 1885-86.
(2) Currie. *Medical Reports on the Effects of Water, Cold and Warm, as a Remedy in Fever and Febrile Disorders when applied to the Surface of the Body or used Internally. 4th Edit. London*, 1805.

(3) Tripier and Bouveret. *La Fièvre Typhoïde traitée par les Bains Froids. Paris*, 1886.
(4) Brand. *Die Wasserbehandlung der Typhösen Fieber.* 4*te. Aufl. Tübingen*, 1887.
(5) Clin. Soc. Trans., vol. xv. *Report of Committee on Rheumatic Hyperpyrexia.*
(6) Fismer. *Kaltwasserbehandlung bei der acuten croupösen Pneumonie. Deutsch. Arch. f. Klin. Med.* 1873.
(7) Jürgensen. *Klinische Studien über die Behandlung des Abdominaltyphus mittelst des Kalten-Wassers. Leipzig*, 1866.
(8) Ziemssen und Immermann. *Die Kaltwasserbehandlung des Typhus Abdominalis. Leipzig*, 1870.

CHAPTER XI.

ARTIFICIAL BATHS.

Hot Air Bath or Turkish Bath.

THIS consists of a series of hot rooms, the temperature of the coolest is about 120° F. and that of the hottest may be as high as 250° F. In these the patient, who is naked excepting a cloth round his loins, stays from half an hour to an hour and a half. If he is not accustomed to Turkish baths he had better first remain for some time in the coolest chamber, and cautiously proceed to the hotter ones. Those who take them frequently can go at once to the rooms they know to suit them best. At the end of his stay in the hot air, the bather is thoroughly kneaded all over; he is then washed, and concludes the bath either with a douche, a needle bath or a plunge in cold water. He does not dress at once, but lies or sits quietly, well wrapped up in towels, in a temperate room till he feels inclined to put on his clothes. During this time he may read and drink a cup of coffee.

The hot air produces an abundant secretion of sweat and considerable hyperæmia of the skin. Some bathers aid this diaphoresis by drinking water before or during the bath. Others contract the cutaneous vessels by throwing cold water over themselves, but whether or not this is done the secretion of sweat is very great, and the evaporation of it and of the pulmonary aqueous vapour prevents, with most persons, the bodily temperature from rising appreciably. In some few however it goes up a degree or so in the hotter rooms. The respiration and pulse are both quickened, and sometimes the heart may be felt to palpitate. According to Bartels and Naunyn the excretion of urea is a little increased. Frey and Heiligenthal say that this increase is not evident till some time after the bath, even as late as the second day, and that if the baths are taken daily, more uric, phosphoric and sulphuric acids are excreted in the urine as long as they are continued, but slowly diminish during some days after their cessation. There is a general feeling of comfort and strength after the bath, which also causes a loss of weight. Manensein gives the limit as from a quarter of a pound to two pounds, but I have known a man lose five pounds in a Turkish bath of an hour and a half's duration. The cold water used at the end of the bath contracts the vessels of the skin energetically.

Because they decrease the weight of the body and cause so much diaphoresis, it is natural to suppose that Turkish baths are powerful excretory agents, and also that they increase the metabolism of the body; this is borne out by clinical experience, for we find that they are a great aid to the absorption of chronic exudations, such as exist in rheumatoid arthritis and long-standing syphilis. They are also used for those who have been chronically poisoned by lead or mercury. Patients suffering from neuralgia or rheumatic myalgia with pain and stiffness, likewise derive much good from them. Many corpulent persons take them habitually, and sometimes successfully, with the object of reducing their weight, but for this purpose they should be regarded only as an aid to dietetics. Frey and Heiligenthal do not forbid them in these cases, even if the heart is suspected to be fatty, but they are so liable to cause syncope and palpitation that it is not advisable to administer them to such patients, unless under exceptional circumstances. They must also be denied to those afflicted with valvular disease of the heart.

Chronic nephritis is alleviated by Turkish baths, on account of the diaphoresis they induce, and if care be taken in the selection of the cases even a hypertrophied heart is not a contra-indication.

Hot Vapour or Russian Bath.

This produces much the same results as a Turkish bath, except that no evaporation of perspiration from the skin can take place, because the surrounding air is saturated with vapour; therefore the temperature of the body rises to a greater height than in a Turkish bath, although that of the bath itself is not so high, but according to Braun it can be borne higher than might be suspected, because the vapour, condensing on the skin and respiratory mucous membrane, forms little drops which cool the parts on which they fall.

A hot vapour bath is suitable for the same diseases as a Turkish bath, and also for inflammatory conditions of the respiratory mucous membrane that require a moist inhalation, but for these the vapour baths must not be so warm as is usual.

Moor, Peat, Mud, and Slime Baths.

Moor, mud, and peat baths are prepared by saturating moor earth at frequent intervals, for years, with simple or mineral water, and mixing the product with warm water so that the whole is of a specific gravity of 1·2 to 1·3. Slime baths are made in a similar way with the deposit formed by low animal and vegetable organisms, and also from the inorganic sediments in rivers. Sea mud is sometimes employed to make a mud bath. The composition of all these is extremely variable, but as far as we know their properties are the same. Some contain iron and sulphur, which are of no importance; the only constituents that could possibly be valuable are formic acid, and certain salts, as chloride of sodium. These might slightly stimulate the skin if they existed in sufficient quantity, which however is not the case. Jacob says that moor baths are not such good conductors of heat as water baths; consequently they take longer to cool or heat the body, and appear to it less warm; for example, a mud bath at 114° F. feels to the bather no warmer than water at 100° F., and hence it can be borne for a longer time than plain water at the higher temperature. Any value that these varieties of baths may have is due to their warmth; and the changes in the pulse, respiration, skin, and bodily temperature caused by them are similar to those produced by a warm water bath, and the maladies for which they are indicated are the same as those mentioned as capable of improvement by warm water baths. Most authors say that mud baths are particularly efficacious in diseases of the spleen, but they do not give a sufficient reason for this statement. As an instance of the effect of a mud bath we may quote one of Kisch's experiments, in which he found a bath of this nature at 100°—104° F. quickened the pulse eight to twelve beats, but in the course of one and a half to two hours it became normal. The respirations were quickened and the axillary temperature was raised about 3° F. The last edition of Braun's *Lehrbuch der Balneotherapie* states that mud baths may be found at the following places: Marienbad, Franzensbad, Teplitz, Eilsen, Nenndorf, Driburg, Pyrmont, Meinberg, Cudowa, Muskau, Augustusbad, Bocklet, Brückenau, Elster, Plinsberg, Freienwalde, Reinerz, and Spa. The mud baths of Marienbad have been recently praised in the *Lancet* by Kisch, especially for chronic rheumatism, for which disease those of Pistyán have also been recommended by Sir Spencer Wells.

Pine-Leaf Baths.

To prepare these a distillate and a decoction made from the leaves of pine-trees are added to water. Probably some of the aromatic principles are taken up by the skin and excreted in the urine, but we have no certain information about the influence of these baths on the body beyond that they are mild cutaneous stimulants. From two to twenty quarts of the decoction are added to each bath, according to the strength required. They are mostly used in cases of rheumatism. Often the decoction is added to cool baths. Pine-leaf baths are to be found at Ildenberg and Andreasberg in the Harz Mountains, at Blankenburg, Eisenach, Rippoldsau, and many other places.

Brine Baths.

A brine bath should contain 2 to 3 per cent. of common salt—that is, about 18 to 27 pounds to every 100 gallons of water. There is no need to use any of the expensive mother lyes so popular in Germany. These baths act in the same way as ordinary salt water (p. 155).

Aromatic Herb Baths.

These are prepared from hay, camomile, gentian, juniper, marjoram, &c. They, like tan, bran, malt, glue, soup, milk, whey, flesh extract, oak bark, starch, soap, corrosive sublimate, mineral acid, chloride of calcium, iron, and sulphur baths, belong, as Leichtenstern says, to the lumber room of therapeutic curiosities, which has not yet been closed.

Mustard baths are prepared by adding ¼ to ¾ lb. mustard to a full bath of about 65 gallons. They are rubefacient and stimulating (see p. 148).

Carbonic Acid Gas Baths.

In these, part of the body, or the whole save the head and neck, is placed in a chamber into which carbonic acid gas is brought. The duration of the bath is from a quarter of an hour to an hour. As in the water baths containing it, so in these, the gas acts as a slight stimulus to the skin, and there is no evidence that they are superior to water baths which hold the gas in solution. Carbonic acid gas baths exist at Marienbad, Kissingen, Homburg, Franzenstadt, Meinberg, Cudowa, and many other places.

Sand Baths.

These were formerly very popular, and lately they have come into vogue again. The sand is dry, and evenly heated throughout to between 116° and 125° F. The lower extremities are covered with it for a depth of five or six inches; the abdomen and thorax for half an inch. The skin soon becomes very red, and perspires copiously; this continues during the bath, but no evaporation can take place because of the sand, consequently the temperature of the body mounts, sometimes as much as four degrees Fahrenheit. The sweat forms with the sand a thin cake, which has afterwards to be washed off by a warm water bath. Local sand baths can be applied to any part, and can be borne even hotter.

Sand baths are serviceable in chronic rheumatism, chronic gout, and chronic Bright's disease—in fact, whenever warmth and diaphoresis are required. Liebermeister and Ziemssen especially recommend them in the dropsy of young children.

For further information consult the authors mentioned in the last chapter, and

Frey and Heiligenthal. *Die heissen Luft und Dampfbäder in Baden-Baden. Leipzig*, 1881.

CHAPTER XII.

ON LAVAGE, OR WASHING OUT THE STOMACH.

Kussmaul, in September, 1867, brought before a gathering of German physicians, held at Frankfort-on-the-Maine, an account of what he then called a new method of treating dilatation of the stomach by washing it out. He subsequently published a paper both in German and French on the subject. In England Dr. Clifford Allbut read a paper before the Medical Society on simple dilatation of the stomach, or gastro-ectasis, in which he advocated the treatment. In France, G. Sée has employed it largely, and in Germany Epstein has used it in infantile dyspepsia. There are many other references to it, but for the most part they occur in articles on diseases of the stomach, and especially in accounts of dilatation of that organ.

The simplest method, and that most frequently employed, is to use a soft rubber tube, closed and rounded at the lower end, but with good-sized lateral opening just above it. This is passed down the œsophagus into the stomach; the end of the tube which comes out of the mouth is attached to a glass funnel by some flexible india-rubber tubing; the funnel is raised above the patient's head, and fluid is poured into the stomach through it till the whole of the tubing and part of the funnel are full; the latter is then quickly turned downwards into a basin placed at the patient's side on a lower level than his stomach. The tube now forms a syphon from the stomach to the basin, and the former may be emptied of the whole of its contents. A very convenient arrangement is figured by Strümpell in his *Medicine* (Eng. trans. p. 373), and Fig. 9 is a copy of it.

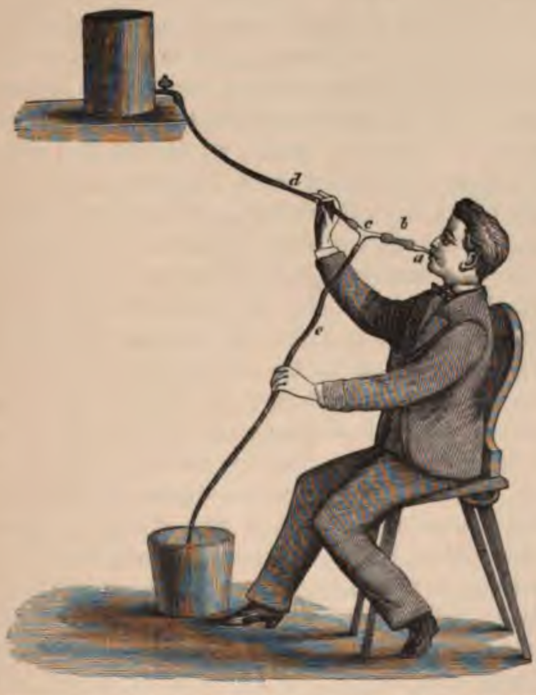

FIG. 9.—Shows upper end of stomach tube (*a*) connected with Y-shaped glass tube (*c*) one branch of which is connected by an india-rubber tube (*d*) with the irrigator, and the other by an india-rubber tube (*e*) with the receptacle on the floor. By alternately opening and closing the two tubes (*d*) and (*e*) with the fingers it is possible to let the fluid flow in and out of the stomach at will.

Whatever apparatus is used, the tube before being passed should be greased with some tasteless grease, or better still, glycerine can be smeared over it, or some prefer simply to moisten and warm it by placing it in warm water. The patient should sit upright with his back well supported and his mouth open; the forefinger of the operator's left hand may be used as a guide, while the tube is passed rapidly with the right. For an adult it should be about the size of an ordinary œsophageal bougie; for infants, tubes of the sizes of Nos. 8, 9, or 10 Nélaton's catheters must be employed. The amount of tubing to be passed differs at different ages, but according to Epstein it may always be gauged by passing past the lips a length equal to the distance from the middle of the forehead to the tip of the xiphoid cartilage. This allows about an inch to be in the stomach, but if this organ is much dilated two or three inches of tube in it will not be too much. There is, however, always a danger that if too great a length be passed the tube will either curl up, or, meeting the wall of the stomach, it will bend at the lateral aperture—a difficulty that can be got over by having the margin of the opening stiffened. Tubes with a number of perforations at the end should never be used, as they are almost certain to become blocked. With adults it is an advantage, and with children a necessity, to have an assistant to take charge of the funnel. While this is being turned down, some means, such as holding the hand over it, should be adopted to prevent any of the fluid from being spilt. The operation may be performed upon children either while they sit on the nurse's lap, or, if they are very young, while they are lying down. It is well to pass a towel round them, and by it to keep their arms fixed to the side of the chest, or they will be sure to catch hold of the tube. With them it is specially important to pass the tube quickly, for the back of the tongue and palate are very sensitive, and a paroxysm of coughing may be induced. As a rule, the younger the child the easier the operation. Those who make most fuss are often quiet when the tube is in the stomach; and when they cry much, it should be passed in one of the intervals between each cry. If none of the contents of the stomach flow when the funnel is depressed, probably some food or mucous membrane is blocking up the orifice; either shifting the tube a little or forcing water down it by pressing along it, usually overcomes this hindrance. If no difficulty is encountered, the stomach, each time the tube is passed may be washed out three or four times till the fluid returns clear. Patients can easily be taught to do it for themselves, and at some hospitals it is usual to take them in till they have learnt to perform the operation without any help; they are then sent home, and told to continue the washing, but to attend as out-patients.

Any of the various forms of stomach pumps may be used, but they have no advantage over the simple method above described, except, perhaps, in cases of poisoning, in which the co-operation of the patient is impossible, and complete and rapid evacuation of the stomach is necessary.

The fluid used should be at a temperature of 100° F. Plain distilled water is as good as anything; Kussmaul used Vichy water, or added to the plain water a few drops of creosote, when he first began the treatment. Dr. Allbut advises a weak solution of boracic acid. Strümpell recommends a 1 or 2 per cent. solution of Carlsbad salts, or if there is decomposition going on in the stomach, a 1 per cent. solution of salicylic acid, or a 2 per cent. solution of resorcine. Epstein employs benzoate of soda, or carbonate of soda of a strength of 1 or 2 per cent. As most of the fluid comes back again, these solutions have probably hardly any advantage over distilled water. The frequency with which the organ is washed out will depend upon the malady from which the patient suffers, but a common direction is for the operation to be employed once a day, or once every other day, and to be continued till the returning fluid is clear. Many patients will not adopt the treatment, as they consider it revolting, but others look upon it as a great blessing. Leube regards lavage as giving us, after examination of the returning fluid, some idea of the extent to which digestion has proceeded.

If performed with care there are no dangers connected with it. Sometimes one meets with the disagreeable complication that the food is vomited up the side of the tube, but this need not prevent the completion of the process. A case is often quoted in which it is implied that washing out the stomach gave rise to tetanus, but reference to the original (Dujardin-Beaumetz et W. Oettinger, *Note sur un Cas de Dilatation de l'Estomac combinée de Tetanie Généralisée*, L'Union Médicale, 1884) will show that probably this was quite an accidental combination.

Conditions for which Lavage is Employed.

Gastroectasis, or Dilatation of the Stomach.—This condition may, if it is severe, be recognized by mere inspection. There is a depression in the abdominal wall just under the sternum, but a large swelling, the shape of the stomach, occupies the middle and lower thirds of the abdomen, and is especially prominent towards the left anterior superior spine. If the distended organ cannot be seen, it can often be felt. It can be marked out by percussion, the exact note depending upon the degree of tympanitic distension and the amount of fluid; on shaking there may be splashing heard, and if the wall is at all hypertrophied, as in pyloric obstruction, peristalsis may be visible. The tympanitic note may extend higher towards the left nipple than it should; the apex of the heart may be displaced, and often there is palpitation. The patient complains of gastric pain, vomiting of filthy fluid, flatulence, constipation, and any or all of the multitudinous symptoms of dyspepsia. He is often much emaciated. Attempts have been made to tell whether a stomach is dilated by passing a sound into it, or by injecting water, but the size of a muscular organ must be variable, and therefore it is difficult to distinguish slight cases of gastric distension by these means, and grave cases can be discovered more easily by other methods.

The conditions leading to gastroectasis, and therefore requiring that the stomach should be washed out, are the following:—

(1) Any form of pyloric obstruction within the stomach, such as a cicatrized ulcer or growth. (2) Any form of pyloric obstruction due to pressure from without, for example, growth or aneurism. (3) Long standing chronic gastritis may lead to a weakening of the gastric wall, and consequent distension. (4) The wall of the stomach may become weak as a part of a general exhausting disease, and thus gastroectasis may occur after acute fevers as rheumatic fever (Allbut, *op. cit.*). (5) Dr. Wilks has recorded an example of paralytic distension, in which it followed injury to the splanchnic nerves. (6) Dr. Fagge, in the *Guy's Hospital Reports*, Series III., Vol. XVIII., has described some examples of that excessively rare condition in which the stomach dilates enormously in the course of a few days. These cases ended fatally, and, as Dr. Fagge says, probably the best way to attempt to avert this termination is to empty the organ, for at the autopsy it returned to its natural size when this was done. (7) Dr. Lauder Brunton considers that sometimes dilatation of the stomach is induced by drinking excessive quantities of fluids, as for example, in the case of persons who have been advised to take mineral waters; and Allbut thinks that others owe their gastroectasis to tea drinking. (8) It has also been suggested that those who are severely troubled by flatulence, or who drink much aerated water, may suffer from gastroectasis as a result of the distension of the stomach by the gas within it. (9) Certain hysterical persons seem peculiarly prone to gastric dilatation. (10) There are many individuals, martyrs to dyspepsia, in whom the exact cause for it cannot be discovered, but physical examination reveals that gastroectasis is associated with it.

Cases could be quoted to show the benefit derivable in all these varieties by washing out the stomach, except perhaps examples of the fifth and sixth would not be forthcoming, as they are very rare. The first nine of Kussmaul's cases are instances in which there was dilatation secondary to ulceration, or growth near the pylorus. All were improved by washing out, or lavage as it is called on the Continent: even those patients who had carcinoma were made much more comfortable. Examples of cure by lavage of dilatation of the stomach associated with hysteria, or dyspepsia, and probably due to a primary weakening of the muscular walls, will be found in Sée's work, and also in an *Essai sur la Dilatation adynamique de l'Estomac*, by de Argaez. This essay contains a good history of the subject. The method must of course always be combined with such drugs and dietetic treatment as the case may require.

Poisoning.—In all cases in which a poison has been taken by the mouth and it has not been sufficiently caustic to render it impossible to pass the tube of a stomach pump, this instrument should be used to wash out the stomach. It is to be preferred to the syphon, because it empties the organ more effectually. It is usually possible to pass the tube after the swallowing of all poisons save the mineral acids.

The Indigestion of Children.—Epstein (*op. cit.*) has treated with considerable success many cases of infantile indigestion, diarrhœa, and vomiting by washing out the stomach. For very young infants, two or three fluid ounces of water is enough to use at a time. Dr. Siebert also advises this treatment for children. He regards it as particularly valuable when it is desirable to remove curds or other food that causes indigestion. Often a single washing is effectual. He uses plain water.

For further information consult:—

(1) Kussmaul. *Arch. Générales de Médicine. April*, 1870.
(2) Allbut. *Med. Soc. Proc.*, vol. xi.
(3) Sée et Mathieu. *Dilatation de l'Estomac. Rev. de Méd.* No. 5, 1884.
(4) Sée. *Des Dyspepsies Gastrointestinales.*
(5) Epstein. *Ueber Magenausspülungen bei Säuglingen. Arch. für Kinderheilkunde. Bd. iv.*
(6) Siebert. *Archives of Pediatrics*, vol. vi., p. 222.

CHAPTER XIII.

MASSAGE.

THE word massage is used to denote the method by which the reabsorption of inflammatory and effete products, and the acceleration of blood and lymph currents are caused by mechanical manipulation.

Schreiber, Reibmayr, and other authors give a full account of its history which we need not stop to consider here. It will suffice to say that descriptions of it or allied methods of treatment are to be found in the oldest Hindoo and Chinese books, and that the Greeks and Romans were well acquainted with it. For many centuries it was little used in Europe, but recently it has come much into favour again. It cannot be too strongly insisted upon that its object is to accelerate, by mechanical manipulation, the flow of blood and lymph in the parts manipulated, and thereby to cause the reabsorption of fluids from them. The method has been brought into great disrepute because many of its advocates have maintained that there is something mysterious in the art which can only be learnt by great trouble from accomplished performers. Many hints can no doubt be picked up by seeing it well done, and the irremediably clumsy person will never be able to do it properly, but the same is true to a still greater extent of operative surgery. If they never lose sight of its object, and remember their anatomy, most persons will, with a little care and patience, be able to perform massage efficiently. By careful training both male and female nurses can learn to do it dexterously, but it is very important that the doctor should see them do it once at least before committing a case to their care, for frequently they have preconceived erroneous notions which require to be eradicated. As in a surgical operation, so in massage, although different operators may have the same end in view, they vary a little in their method of carrying it out. For the benefit of those who have not seen it performed, I give the following description.

Let us suppose that the lower extremity is to be massaged. First if the hair is long it should be cut close, then if the operator prefer it, the skin may be greased all over with vaseline or other grease, but if it be found that greasing makes the skin too slippery, this can be omitted. At first I always used grease, now I have given it up, as I seem to get a better hold without it. Then, beginning at the toes, the foot should be firmly stroked several times with the ulnar edge of the hand on both the dorsum and the sole, the same should be done to the leg from the ankle to the knee, and to the thigh from the knee to the hip. For these larger parts some find the whole hand better than the ulnar edge of it. If we recollect the arrangement of the valves, it is easy to see that the desired object of aiding the flow in the superficial veins will be attained by this stroking, which must always be in the direction of the venous flow; if there be a difficulty in accomplishing this, as in the back, the stroking should be in a uniform direction. Again beginning at the toes and working upwards, a fold of skin should be pinched up between the thumb and forefinger and lightly twisted so as to give no pain, and the whole skin of the limb should be treated in this way; the beneficial effect in aiding the cutaneous circulation is at once seen in the redness produced; both hands may be employed, one following the other. After this the muscles are to be grasped between the thumb and fingers, or, if it be more convenient, between the fingers of the two hands, and thoroughly kneaded from below upwards, the aim being to accelerate the flow of lymph and blood in them. Then passive movements should be made of all the joints, such as the toes, ankles, knees and hips, partly with the same object as that for which the muscles were kneaded, and partly to aid the absorption of any fluid there may be in them. Many operators, in addition, employ one or more of the following manipulations: pressing the muscles slowly upwards with the tips of the fingers, tapping or thrusting at the part with the extended finger tips, or hitting several successive blows with the ulnar border of the hand, a method which Schreiber and others call hacking. Any or all of these manipulations may be used; they are chiefly indicated in painful affections such as neuralgia and rheumatism, but special methods will be mentioned under the heading of the disease to which they are applicable. Massage can either be performed upon the naked body, or if it be preferred, thin, closely fitting clothes can be worn, but this is not to be recommended.

There is much evidence that massage is likely to be useful in medicine. Reasoning from our physiological knowledge we should naturally conclude that because mechanical stimulation causes the arteries of a part to dilate, and the movement of muscles and the centripetal stroking of veins and lymphatics quicken the flow of venous blood and lymph, therefore massage would aid the circulation, and quicken the absorption both of inflammatory products and the results of tissue waste. As proof that this is so there is the clinical fact that chronic inflammatory exudations do disappear under massage, and there is also a considerable amount of confirmatory experimental evidence.

Von Mosengeil injected coloured fluids, such as carmine or indian ink, into both elbows and both knees of some rabbits; the joints on one side of the body only were manipulated, and the fluid was seen rapidly to disappear from them. The animals were shortly afterwards killed; the lymph glands and the lymph channels on the side on which the joints had been manipulated were found filled with coloured particles; on the other side, although the fluid had been injected into the joints, the lymph glands and channels contained no coloured particles. Reibmayr showed that the absorption of water injected into the abdominal cavity could be accelerated considerably by massage of the abdominal wall. Zabludowsky made a series of experiments upon fatigued muscles, and found that if they were massaged their capability to respond to electrical stimuli was more quickly recovered than after simple rest. From these and somewhat similar experiments by Kronecker and Stirling, there seems no doubt that massage may be looked upon as a means both of rapidly removing waste products from a muscle and bringing new nourishment to it. Reibmayr points out that massage benefits not only by its direct effect upon the muscle, but also by reflex effects, as is proved by the quickened pulse and respiration.

Godpadze (*Lancet*, vol. i., 1886, p. 982) states as the result of experiments upon healthy young men, that massage increases the appetite, that the nitrogenous transformation and assimilation are increased independently of variations that might be due to alterations in diet, that there is a gain in weight, and that the respirations become deeper and more frequent, but that the pulse is sometimes slower and sometimes made more rapid. Other observers have obtained the same results, and it has been shown that abdominal massage increases the peristaltic movements of the intestine, and probably also the functional activity of the liver. Dr. Eccles has in the *Practitioner* and *British Medical Journal* (December 1st, 1888) recorded a series of observations he made upon the effects of massage on healthy individuals, and his results are confirmatory of those just quoted. As showing its restorative influence upon fatigued muscles, he mentions one experiment in which a man was made to rhythmically grasp a dynamometer till the hand was so tired that the instrument only registered five pounds; after ten minutes' rest the patient was able to register about ten pounds; but even if the muscles were more exhausted than in this experiment and massage was performed upon them for ten minutes, they could then register forty-five pounds. As proof of the increased absorption from muscles by massage it may be mentioned that Graham Brown and Eccles have both been able to reduce the circumference of a limb as much as ⅜ of an inch by this means. The last-named observer also showed that although massage of the extremities nearly always considerably increases the rate of the pulse, abdominal massage, as might have been expected, decreases it; therefore it is better in general massage to operate upon the abdomen first in order that the depressing effect may be overcome by the subsequent manipulation of the extremities. From one hundred observations he gathers that generally massage temporarily increases the blood pressure and the external bodily temperature, whilst that in the rectum falls, unless the abdomen is the only part operated upon, when the results are reversed.

If we bear in mind the physiological effects of massage it will not be difficult to decide upon the diseases for which it is most likely to be beneficial. They are the following:—

Diseases of Joints.—The medical diseases comprehended under this heading are, chronic rheumatic arthritis, gonorrhœal rheumatism, and gout. Great care is required to decide which cases are suitable for treatment by massage. Joints that are acutely inflamed, or those containing pus are still further damaged by it, and if its effect is to set up or increase inflammation it must be discontinued. When there is any infective material in a joint it must not be massaged, as massage might render general infection more easy. Then again massage is useless in cases in which the joint is fixed by bony out-growths or firm fibrous adhesions. But the absorption of chronic exudations, both inside and outside the joint, may be forwarded by this treatment. It would be useless to attempt to describe the most suitable form for each case. The good judgment of an operator is shown by his adopting such manipulations as will best further the absorption of exudation. Slow uniform rubbing of the joint and its neighbourhood should be largely employed; the anatomy of the parts should be carefully recollected, and the rubbing must always be in the direction of the veins and lymphatics leading away from the joint. Many chronic cases are improved simply by passive movements. Massage of the muscles and tendons in the neighbourhood of the articulation often aids recovery, for frequently there is some effusion into their sheaths, it relieves the stiffness due to long fixture of the parts in one position, and the manipulation of the muscles quickens the flow of venous blood in them and away from the joint. The good which this method is capable of doing in intra-articular effusion is seen in Von Mosengeil's experiments which have been previously mentioned. The number of applications varies in different cases, but one or two a day, of ten minutes to a quarter of an hour each for each joint, is the number often employed.

Muscular Rheumatism or Rheumatic Myalgia.—We do not know for a certainty the pathology of this malady, and therefore cannot explain why massage is frequently very useful. It should be performed upon the affected muscles once or twice a day according to the severity of the case, and the passive movements should be devised so as to bring the muscles into play. Active movements of them are also very valuable, and after a little while the patient will find that he is able to move them more and more each day.

Sciatica.—In the *Practitioner* for November, 1887, Dr. Eccles has recorded cases of this disease which were much benefited by massage of the affected limb. All the usual manipulations except passive movements were employed, and these were usually added to the massage in a fortnight or three weeks from the commencement of the treatment, which lasted one, two, or even three months according to the severity of the case. For the greater part of this period the limb was kept absolutely at rest, except during the massage, by swinging it in a cradle. The time devoted to each performance should be about ten minutes, and it should take place once or twice a day. Dr. Eccles, like most authors, is in favour of absolute rest to the limb, but Schreiber does not enforce this, and begins with passive movements and then passes on to the other manipulations. Often no improvement is at first observable, but the treatment must be continued. The limb may, after each performance, be hacked or stabbed with the fingers, especially over the nerve. Schreiber has made considerable use of various muscular exercises; the patient being induced to make the movements however severe the pain they cause. This treatment is obviously only applicable to those cases of sciatica in which no removable cause can be discovered.

Neuralgia.—Many authors, as Reibmayr, speak very strongly in favour of massage over the painful areas of neuralgia, but it is clear, considering the parts of the body in which neuralgia most often occurs, that the whole of the treatment cannot be carried out; nevertheless much alleviation often results from stroking the parts, and giving the painful nerves many repeated small blows with the tips of the fingers, the side of the hand, or a mechanical percussor.

Muscles paralyzed from neuritis, or anterior poliomyelitis, may be gently rubbed once or twice a day, but the inflamed nerve must have absolute rest.

Chronic Constipation.—Godpadze and many others have urged the desirability of treating this complaint by massage, and Dr. Garry (*Lancet*, March 2, 1889) has recently recorded a series of successful cases. I have had under my care a man who had

had constipation for thirty years; for a long time all the usual purgatives had been useless, and large enemata could not be depended upon to move the bowels. Massage completely cured him; and when last I heard of him many months after, he had suffered no more inconvenience. A lady whom I saw not long ago had had constipation almost as severe and long-standing. She also was cured by abdominal massage.

It should be applied in the morning before the patient gets up, so that the bowels may be moved at the natural time. The object the operator should have in view is to act upon the muscles of the abdominal wall, and also upon the unstriped muscle of the colon. To secure these ends the massage should proceed up the right side of the abdomen, across at a little above the umbilicus, and down the left side, so that it may follow the direction of the colon. At the commencement of each operation the massage should be performed superficially, so as to influence the muscles of the abdominal wall; afterwards the manipulations should be as deep as possible in order to affect the colon directly. This can be done by pressing deeply and moving the hands with a kind of rotatory motion, and then pushing them well down into the abdomen in the direction of the colon. Often the cases are quickly cured, but in very obstinate ones it may be necessary to continue the treatment for six weeks. The duration of the operation should be ten or fifteen minutes daily. Frequently it is advantageous to additionally stimulate the muscles by the faradic current (see p. 287).

Writers' Cramp.—This disease has often been treated by active and passive movements of the affected muscles, and by massage of them. Sometimes this treatment has appeared to do good; at others it has been quite worthless. At present we do not know enough of the pathology of the disorder to foretell in which cases it will be useful. The active movements consist in a rapid opening and shutting of the hand, and the free use of the muscles which appear to be affected. At first these movements are performed for about five minutes a day; the time is gradually increased to half-an-hour. The passive movements consist of traction on the affected muscles, together with massage of them. The operation concludes by striking them several times with the ulnar border of the hand. Poore recommends this method combined with electricity (see p. 283), and Gowers also considers movements and massage useful; but by far the most important element in the treatment is rest from writing.

Insomnia.—Dr. Eccles has in the *Practitioner* described a mode of treating inveterate sleeplessness, which consists in thorough rapid massage of the abdomen and the extremities, with the object of bringing away blood from the brain to fill the dilated vessels of the massaged parts. After this the expansion of the vessels is maintained by a hot abdominal compress, and the patient is immediately put to bed for the night. It is said that this treatment "usually culminates in peaceful sleep."

Disorders such as hysteria and certain forms of indigestion for which massage forms only a part of the Weir Mitchell method, or some modification of it, are described in Chap. XIV. There is hardly a single disease for which massage has not been tried, but in most, save those previously mentioned, it has been found to be useless. It has been applied to the eyeball for the cure of certain ocular affections. An account of its performance for this purpose is to be found in Hünerfrauth's *Handbuch der Massage.*

There is at present such a craze, which is assiduously fostered by a number of quacks, to have every conceivable ailment treated by massage, that it would be desirable to have a list of diseases in which it is absolutely contraindicated. This is however impossible, for we have not at present sufficient unprejudiced scientific observations, and the importance of such a list is less than it seems, for massage should always be commenced by a very short sitting once a day, and the duration and frequency of the performance should be gradually increased, so that if it be found not to benefit the case it may be stopped before any harm is done. It is quite possible that great injury may result if this course is not followed. Therefore it is most necessary that no one should adopt treatment by massage without the sanction of a doctor, who should himself give careful directions as to the part to be massaged, the length and frequency of the sittings, &c., and he must be quite certain that the performer is to be trusted to carry out the directions efficiently.

I have seen it do harm by increasing the rapidity of the pulse and dyspnœa in a case of slight mitral disease, and I would urge that it should always be applied with the greatest caution in cases of cardiac disease, and that the physician should either do it himself, or at least be present during the performance. I have also seen an extremely excitable and nervous person made even more so by massage. It ought never to be used when there is any suspicion of thrombosis lest it should dislodge a clot, and it should be employed with great caution in all maladies such as chronic Bright's disease, atheroma, or syphilitic arteritis, in which there is reason to suspect that increased force of the circulation may lead to rupture of the vessels. It is of course absolutely forbidden if the patient have an aneurism, and it is hardly necessary to say it should never be performed upon any case, such as one of gastric ulcer, in which there is any risk of perforation or hæmorrhage. For the last reason it must be used with great judgment in phthisis. As has been mentioned when speaking of joints, any part which is acutely inflamed or contains pus is still further damaged by massage.

Some patients so insist on having it tried that even if we think it can do no good, we are justified, if we are quite sure it can do no harm, in trying it in order to demonstrate to them its uselessness, for by so doing we prevent their falling into the hands of charlatans.

For further information consult :—

(1) Schreiber. *Manual of Treatment by Massage. Translated by W. Mendelson. London*, 1887.
(2) Reibmayr. *Die Massage, und ihre Verwerthung in den verschiedenen Disciplinen der praktischen Medecin. 4te. Aufl. Wien*, 1884.
(3) Busch. *General Orthopædics, Gymnastics, and Massage.* Ziemssen's *Handbook of General Therapeutics*, vol. v. *Eng. Trans., Lond.*, 1885-86.
(4) Douglas Graham. *A Practical Treatise on Massage, its History, Mode of Application, Effects, Indications, and Contraindications. New York*, 1884.
(5) Weir Mitchell. *Fat and Blood. 4th Edit., Philadelphia*, 1885.
(6) Playfair. *The Systematic Treatment of Nerve Prostration and Hysteria. Lond.* 1883.
(7) Hünerfrauth. *Handbuch der Massage. Leipzig*, 1888.

CHAPTER XIV.

THE WEIR MITCHELL METHOD.

This method of treatment consists of five parts: strict isolation of the patient, absolute rest in bed, massage, electricity, and overfeeding. It is named after Dr. Weir Mitchell because he was the first to use these means systematically in combination with each other. In certain cases one or more of them may be omitted.

The class of patients best suited to this method are neurotic hysterical women in whom there is much loss of flesh, but it may also be employed for men; the chronic neurotic dyspeptic may often be completely cured, as in the well-known case published by Dr. Lauder Brunton in his *Disorders of Digestion*. This patient, who had wasted to a mere skeleton, became, under treatment lasting eight weeks, a well-developed man.

The following are some points which we ought always to have before us:—

The thinner the patients the more likely the treatment is to succeed, and if they are overladen with fat the chance of improvement is slight. I have seen the method fail absolutely in those who were stout. This was so with one patient especially, a hysterical girl, who was in every other respect suitable, but the treatment ended in complete failure. Dr. Playfair says: "There is still another class of patients, the fat, comfortable, well-feeding hysterics. . . . These had unquestionably best be left alone."

The nearer a case is to insanity the less the likelihood that the treatment will do good; and if the patient be clearly insane it had better not be tried. One patient that came under my care did not get on at all. After some time I found that she had several years before been in a lunatic asylum. Melancholics do not improve by this method. I have seen it tried in a case otherwise fit for it with the only result that the melancholy was profoundly increased.

Most severe organic diseases contraindicate it.

The isolation is the most important part of the system. I have twice known cases in which all the details had been carried out except that the patient had not been isolated; in each instance she began to improve directly it was enforced. The isolation must be absolute; any attempt to treat the patient in her own home ends in failure. She must be removed to a clean, cheerful room, where she must be kept for a period of from four to ten weeks, according to the severity of the case. During this time she is to be allowed to see nobody excepting the nurse, the person who does the massage, and the doctor. Neither the receiving nor the writing of letters is, as a rule, permissible. The treatment without the isolation must be restricted to those who are merely thin and weak, without any taint of hysteria, for all they require is a prolonged rest and abundance of food. For such, however, this modified form of the treatment is most valuable. Massage is not for these patients an absolute essential, but as a powerful stimulant to the enfeebled muscular system, it is a most valuable adjunct to the rest and overfeeding.

For the first four to ten weeks complete rest in bed must be enforced. If the case be a bad one, the patient should not be allowed to get out to relieve the bladder or rectum, and she should be fed by the nurse. In the morning and evening she may be lifted on to a stretcher to have her bed made. She must not be allowed either to read or sew. This absolute rest does not, as might be thought, weary her, it is surprising how kindly she takes to it. At the end of a fortnight the nurse may read to her, and soon after she may sew or read to herself. At the end of the rest in bed she may get up for a short time, which may be lengthened each day, beginning by sitting in an easy-chair for about half an hour, and after a few days trying to walk a little. In slight cases such complete rest is not needed, but it is better to err on the side of too much rather than on that of too little.

The massage must be applied to the whole body in the manner already indicated. It is usual to omit the face and head. Often there are painful spots massage of which causes the patient to flinch, but it must be persevered in, and after a few applications the pain will disappear. It is better not to begin this part of the treatment till she has been in bed a day or two, and at first to do it only for a quarter of an hour at a time, but in a few days its duration may be gradually increased, till by the end of the first week the performance lasts an hour. In some cases once, in others twice a day will be found to suffice. If twice a day, forty minutes each time are enough. During menstruation the abdomen should not be massaged, but at other times it should, because by that means the liability to constipation will be overcome. To begin with, the massage may be lightly performed, but soon it should be done deeply. It must be performed daily for from four to ten weeks, and when it is left off the diminution must be gradual, less and less time each day for about a week being devoted to it. The face will be seen to get fat first, the legs last. As each part is massaged it should be covered up; for this purpose it is well to have the patient lying in a large blanket, and when any part is finished a fold of the blanket can be thrown over it, and after the whole body is done the patient must be left to rest a while, and be kept thoroughly warm. If the massage is to last half an hour a good subdivision of the time is: lower extremities and upper extremities five minutes each or twenty minutes, five minutes for the abdomen, and five minutes for the back.

There is nothing particular to say about the mode of applying electricity. The faradic current is the one to be used, and the various muscles of the body are to be stimulated in turn; to do this efficiently, a knowledge of Ziemssen's motor points is necessary (see p. 264). The application should take place once a day. The current should be as strong as possible provided that no pain is caused. Electricity is only an addition to the massage, its effect is the same, the object being to induce muscular contractions. Many cases get well without it.

The guiding principle of the overfeeding is that the patient should have an abundance of easily digestible food at frequent intervals. At first milk should be given in quantities of about four ounces every two hours, and if it disagree it should be skimmed, or a little lime water or barley water should be added. If its taste be extremely disagreeable it may be flavoured with a trace of tea, cocoa, or coffee. After a week or a fortnight of the exclusively milk diet, during which time the quantity has been gradually increased, a little toast or bread and butter may be allowed, next some fish, or chicken at mid-day, and at the next stage the same for breakfast and supper with a chop or other form of mutton at mid-day; also strong beef-tea, plain soups, jellies and milk-puddings may be added; a patient who is going on well will by the second or third week take enormous quantities of food, as will be seen from the cases about to be mentioned. The following diet list from Dr. Playfair's book shows how much a patient was taking on the tenth day of treatment: Six A.M. ten ounces of raw meat soup; 7 A.M. a cup of black coffee; 8 A.M. a plate of oatmeal porridge with a gill of cream, a boiled egg, three slices of bread and butter, and cocoa; 11 A.M. ten ounces of milk; 2 P.M. half a pound of rump steak, potatoes, cauliflower, a savoury omelette, and ten ounces of milk; 4 P.M. ten ounces of milk and three slices of bread and butter; 6 P.M. a cup of gravy soup; 8 P.M. a fried sole, roast mutton (three large slices), French beans, potatoes, stewed fruit and cream, and ten ounces of milk; 11 P.M. ten ounces of raw meat soup. The exclusively milk diet that is used at the beginning of the treatment is liable to constipate, but not so much so as might be thought; any simple purgative will get over this difficulty. The urine often has a peculiar greenish-yellow tint when seen in bulk. There may be at the commencement a slight diminution in weight; soon, however, there is a great increase. I have seen a patient gain ten pounds in fourteen days.

A refined nurse, who is a good companion, cheerful, good-tempered, firm, and not in the least inclined to sympathize with the patient, must be chosen. A woman who shows want of delicacy, or who is quick-tempered, will never do. Often, if the case is not getting on well, it will be found that the patient begins to mend directly the nurse is changed.

After what has been said about the physiology of massage it is easy to see what beneficial effects it and faradism must have in aiding the circulation both generally and in the muscles, and as a result all sorts of waste products are carried away from them and new blood is brought to them. The absolute isolation and rest are for the cure of the mental part of the case, and the overfeeding is to compensate for the enormous loss of flesh.

Schreiber (*Berl. Klin. Woch.* No. 52, 1888) fully confirms the results of Playfair and Weir Mitchell, by showing how much good this treatment does in suitable cases.

Morphia, Opium and Chloral Habit.—Dr. Weir Mitchell has pointed out that the miserable subjects of these habits may be completely cured by the same means of isolation, absolute rest, overfeeding, electricity and massage. Dr. Sharkey, in the last volume of the *St. Thomas's Hospital Reports*, has recorded some cases, of which many were successful. The method of treatment is exactly the same as that just described for hysteria.

It has been shown by Drs. Goodhart and Phillips that chorea may be successfully treated by the same method, save that isolation is not necessary. It is to the more acute cases of chorea that this system is chiefly applicable.

The following case is introduced to show the value of this treatment in hysteria:

I saw Miss M—— in the spring of 1887. Three years previously she had suffered from hysterical vomiting. When well she was strong, active, and energetic. For six months she had had much anxiety and overwork, under which she broke down. Uncontrollable vomiting set in. She was sent to a pay bed in a general hospital, where she was fed and massaged, but not isolated. After six or seven months' treatment she was discharged worse than she was when she came in. When I saw her she was a complete skeleton, vomiting everything, even plain water. Lodgings were taken for her where she would be completely isolated from every one except the nurse and doctor. On April 9th the treatment began. At first she had milk in small quantities and at frequent intervals, beginning with half a pint daily and reaching three pints on the sixth day. Then she was allowed a little jelly, and some of the milk was coloured with tea. April 19th she had some toast. April 20th. Up to this date the sickness had been lessening day by day. On this day she was not sick. During the remainder of her treatment there were only five days on which she was sick, and then not severely. The last time was May 4th, then it was slight and might be attributed to some of her food being underdone. The principle of the dietary was to give her abundance of easily digestible food frequently during the twenty-four hours. She had much fruit, partly because she liked it and partly to keep the bowels open. As examples we may take the following days:—April 23rd, 7 A.M. oatmeal and plenty of bread and butter. 11 A.M. jelly and bread and butter. 1 P.M. as at 7 A.M.; 4 P.M., 7 P.M., and 11 P.M. as at 11 A.M. She also had during the twenty-four hours two and a half pints of milk, two oranges, two lemons and some honey. April 30th, 6 A.M. tea and bread and butter; 8 A.M. oatmeal and bread and butter; 11 A.M. jelly, stewed apples, and bread and butter; 1 P.M. broth, custard, stewed rhubarb, and bread and butter; 4 P.M. boiled eggs, stewed rhubarb, and bread and butter; 7 P.M., oatmeal and bread and butter; 11 P.M. bread and butter; and during the twenty-four hours two pints of milk, a lemon, and some honey on her bread. May 8th, she had eight distinct meals, including amongst other things chicken, vegetables, jam, sponge-cakes, and at intervals during the day she consumed two pints of milk. Shortly after this she had for her meals exactly the same food as the healthy inmates of the house; but she had twice as many meals, and about three times as much food as an ordinary woman, although for the previous eight months she had been sick after everything she had taken. Massage was commenced on April 11th, and discontinued May 18th. It was both begun and left off gradually. The full time of an hour night and morning lasted four weeks. She was kept entirely in bed till May 8th, when she sat up to have it made. For the first four weeks she was not allowed to write or receive any letters, and no friend was permitted to visit her till the end of the fifth week. As she lay in bed she was allowed to do a little needlework, or to read a light novel. Two days before she went away she weighed nine stone six pounds, and was able to walk a mile in the street, to get up and down stairs, and to take a cold bath in the morning and a warm one at night. She drove away in a hansom cab to go a long railway journey exactly six weeks after the treatment began. No drugs were used. I have heard of her since, and she remains quite well.

For further information consult:—

(1) Weir Mitchell. *Fat and Blood. 4th Edit. Philadelphia*, 1885.
(2) Playfair. *The Systematic Treatment of Nerve Prostration and Hysteria. Lond.*, 1883.

CHAPTER XV.

VENESECTION.

THE history of venesection is extremely interesting. Fifty years ago it was most extensively practised, and numbers of people came regularly to be bled in the spring and fall as a matter of routine, whether or not they had anything the matter with them. Several might be seen lying on the floor of the surgery at Guy's Hospital, having fainted after their periodic bleedings. So orthodox was the practice, that fifty years ago legal proceedings were taken against a doctor who did not bleed a patient suffering from pneumonia. Now it is rarely done—so infrequently that occasionally a student may go through the whole of his hospital training without happening to be present at a venesection, and I have read of a surgeon who said it was quite unnecessary to teach to his practical surgery class the method of performing it. Jürgensen says: "What I have seen of it has been incapable of leaving any doubt in my mind that this treatment is seldom, perhaps never imperative." I shall presently show that this overstates the case, for often venesection is the only right treatment; nevertheless, the experience of the present generation of physicians demonstrates that the diseases which were formerly treated by it generally recover more easily without it, and experimental evidence proves that it is distinctly harmful when carried to the extent to which it was carried formerly. The controversy concerning the merits of venesection reached its height about the fifth and sixth decades of the present century. It was known as the "blood-letting controversy," and often waxed so warm that very little benefit is to be derived from reading many of the papers about it, for they are written in a partisan spirit.

Let us first of all consider a few facts that have been proved experimentally about venesection, and we will then see what application they have in medicine.

The blood pressure is but very transitorily altered by withdrawing blood, unless the quantity abstracted is at least a third of that in the body. The rate of the pulse is at first accelerated, but as the bleeding goes on it decreases. The fluid part of the blood is very quickly replaced; if this were not so, the proportion of corpuscles to fluid ought not to be altered by bleeding, but the following table from Vierordt shows not only that it is altered, but it also indicates the great rate at which fresh fluid must be added to the blood after venesection.

No. of depletion.	Amount of each depletion. Grms.	Time of each depletion.	Investigation was made after last depletion.	No. of corpuscles in 1 cub. mm. of blood in millions.
		h. m.	min.	
1st	4	1·47	0	4612
2nd	55·7	1·50	16	4110
3rd	68·4	2·7	20	3737
4th	72·5	2·29	19	3475
5th	96·1	2·50	16	3743
6th	20·0	3·8	0	3175
7th	27·3	3·15	0	2371

The solids of the blood plasma are not replaced nearly so rapidly as the fluid, or, in other words, venesection causes a dilution of the plasma, the specific gravity of which was found by Davy, in the case of lambs that had been bled to death, to fall from 1024 to 1018, and in the case of oxen it fell from 1.027 to 1021. Lesser's experiments show that this fall takes place even if the thoracic duct be ligatured; therefore there must be a return of fluids directly from the tissues to the blood, and this must happen immediately after bleeding. For some days afterwards the number of small red-blood corpuscles is considerable; they however become fewer as the number of those of the proper size becomes greater. There is no increase in the number of white corpuscles. We do not know enough to be able to make any definite statement about the other constituents further than that, as might be expected from the loss of hæmoglobin, bleeding leads to a diminution of the oxygen in the blood. Buntzen has shown that after venesections which produced a loss of weight between 1·1 per cent. and 4·4 per cent. of that of the body (14—50 per cent. of the whole quantity of blood) from 7 to 34 days are necessary for the restoration of the blood corpuscles, the renewal taking place more quickly during the first few days than afterwards.

Bauer's results prove that when the loss of blood has been considerable there is an increase both in the amount of urea and the amount of urine excreted, and this continues even when no more than the usual quantity of fluid is ingested. Considering the amount of fluid that has been withdrawn from the blood, this is an extraordinary result, and before accepting it the experiments must be repeated. One possible explanation is that bleeding is said to cause a decrease in the excretion of water by the skin and the lungs; another is that the diminution in the quantity of blood leads to a rapid passage of fluids from the tissues into it. The same experimenter concludes "that in consequence of venesection the decomposition of albumen increases, and the elimination of carbonic acid on the contrary decreases. From this therefore it is clear that the decomposition of fat must be smaller, whether it come from the food, the fat which is stored up in the body, or that which results from the breaking up of the albumen." As will be seen directly, this is supported by the experience of those physicians who practised during the period when bleeding was universal, for their opinion was that frequent blood-letting most certainly led to an accumulation of fat.

Experiments upon the alteration of temperature produced by bleeding are unsatisfactory, and the results are so contradictory as to be valueless. It is well known that in man the sudden loss of a large quantity of blood reduces the temperature considerably, but in long standing anæmia it is usually raised. At present our knowledge of fever is too elementary for a discussion on the effect produced by bleeding on its temperature.

As might be expected, the activity of the gastric juice and bile is diminished. Experiments also teach us that the withdrawal of blood from the brain consequent upon bleeding, causes convulsions, unconsciousness, loss of sensation, paralysis, and impairment of vision. The anæmia of the respiratory centre leads to a diminution in the number and depth of the respirations, but this soon passes off; sometimes Cheyne-Stokes respiration is produced.

Having briefly glanced at the experimental facts connected with venesection of animals, let us now consider the effects in man.

A slight venesection has no harmful influence upon healthy persons, but produces a feeling of ease, lassitude, and an inclination to sleep.

When *a large quantity* of blood is withdrawn, as is well known nowadays from the study of cases of hæmorrhage from the lungs, stomach, or uterus, the symptoms are very severe. In former days, as was pointed out by Marshall Hall, they could frequently be noticed after venesection. In his great work (*Researches Principally Relative to the Morbid and Curative Effects of Loss of Blood*, 1830) he gives, as the immediate effects of bleeding, pallor, syncope, giddiness, unconsciousness, eructation, and sickness; the respirations are slow and deep, the pulse is slow and weak, the face and general surface become pale, cool, and bedewed with perspiration. On recovery there may be momentary delirium, but as consciousness returns the patient yawns, sighs, and breathes irregularly, and his pulse gradually regains its strength. He is often better after he has vomited.

In fatal cases the countenance becomes more pale and sunken, consciousness may remain till the last, generally there is some delirium, the breathing becomes stertorous, and at length terribly gasping, there may be no efforts to vomit, the pulse is extremely feeble or even imperceptible, the extremities become colder and colder, there are constant restlessness and jactitation; at length the strength fails, the patient sinks, gasps, and expires. Marshall Hall adds, as other immediate effects of loss of blood, convulsions and coma. As an example of convulsions he gives the case of a physician who had inflammation of the larynx; he was bled freely on two successive mornings, and on the afternoon of the second day to thirty-four ounces. He then suddenly fell on the floor violently convulsed. Another man hurt his back; in three days he was freely bled four times, and cupped and purged, after which he became delirious and died. Sometimes neither convulsions nor delirium are present. Thus a man who fractured three ribs was brought to the hospital early one morning. At once eighteen ounces of blood were withdrawn, and at noon twenty more were taken. The next morning eighteen more, and at noon another eighteen, and the same in the evening. The third morning twenty ounces were withdrawn; the pulse after this became a mere flutter, and the man only survived a few hours.

The *recovery* from syncope due to a single venesection is generally a simple return to the healthy state. If there be one or two very severe or frequently repeated minor blood-lettings the recovery is different. Then there is excessive reaction, characterized by rapidity and irregularity of the heart and pulse, with throbbing of the vessels, pain in the head, intolerance of light, noise, or any kind of disturbance, noises in the ears, flashes of light, frightful dreams, and even delirium. The respiration is frequent, hurried, and accompanied by panting and sighing. Sometimes there is amaurosis. The skin may be very hot.

In old or feeble persons and infants these symptoms are absent. The patient remains pale, feeble, deaf, and dozing, with a frequent but weak and irregular pulse.

Reaction may terminate in recovery, gradual sinking, or sudden death. A mistake frequently made was that of considering the reaction as evidence of further inflammation. The result of this was that the patient was again bled and soon died.

Frequent or prolonged loss of blood also causes the following symptoms, all of which remain for some time: a marble-white skin, pallor of the internal organs, serous effusions, œdema of the ankles, empty blood vessels, a hæmic murmur, dyspnœa, amenorrhœa, and in many people it leads to an increase of fat in the body.

Thus we see that in the points which it is possible to compare, the effects of bleeding are the same both in animals and man.

We are now in a fit position to discuss the question of the utility of bleeding in disease. Here it is well to bear in mind the extraordinary differences that exist in different people with regard to their capability of enduring venesection. Thus, Marshall Hall says: "I have known a patient, not apparently very feeble, faint on losing four ounces of blood; and I have known patients bear to lose fifty, sixty, and even seventy ounces of blood without syncope." Hence, the same author says that a patient should never be bled in the recumbent posture, for when sitting or standing syncope can be observed more readily, and we are enabled to stop the bleeding at the earliest stage of any bad effects. It so happens that most of the patients whom we bleed at the present day, are, from the nature of their malady, sitting propped up in bed, so that we unknowingly follow Marshall Hall's directions. This, however, must not prevent our watching the pulse and respiration, and looking out for any signs of syncope.

It is impossible to discuss the reasons why bleeding was practised for many diseases. There were none; the treatment was the fashion of the day. There was no disease or condition in which the patient was not liable to be venesected; for example, those who had suffered from operations or serious accidents were frequently bled. Why this was wrong, hardly now-a-days merits serious discussion. It was perhaps in various inflammatory diseases that bleeding was thought to be most efficacious. Let us consider the reasons against continuing it for these maladies.

We have seen that after the withdrawal of blood the number of red-blood discs is diminished, and that it takes some time before the proper number is regained. As a result the patient has less hæmoglobin, and consequently less oxygen, so that by bleeding him, we deprive him of that which of all other things is probably the most important for him. There is never any justification for venesection unless the good it does more than compensates for the great harm done by a deprivation of oxygen and hæmoglobin lasting for some days. What are the possible good effects of bleeding in inflammation, and do they compensate for this great evil?

It is said to be antipyretic. Supposing we grant that benefit accrues from reducing a moderately high febrile temperature—a point which is quite open to discussion—we must inquire how potent bleeding is for this purpose. There is no doubt that although in health the loss of blood must be very large to reduce the temperature, sometimes even a moderate deprivation of blood, such as may result from epistaxis, will reduce a febrile temperature. Wunderlich gives an example in which epistaxis reduced the temperature from 104° to 100° F. in a case of typhoid fever. But if the old cases of bleeding for fever are examined it will frequently be found that no relief of the febrile symptoms followed the bleeding, unless the operation was repeated again and again. Thus "the pulse was 90, full and hard, and the surface hot. She was placed quite erect, and bled to syncope; this took place when thirty-nine ounces of blood had flowed. The pain being relieved but not entirely removed, calomel and purgative medicines were given. In the evening the pain had increased, the pulse remained as in the morning; the medicines had acted well" (Marshall Hall). Traube likewise teaches that the antipyretic effect of venesection soon passes off. We therefore sacrifice such an all-important part of the body as the red-blood corpuscles to gain a possible transitory fall of temperature, even when the advantage of such a fall is doubtful. Surely the game is not worth the candle. Should it be urged that venesection will reduce the blood-pressure and pulse-rate in fever, we need only refer to the experiments upon animals already quoted, and to the old reports of fever patients who were bled, both of which references will show that unless the quantity of blood taken is enormous, any diminution in pressure and pulse rate soon disappears.

Then again it is said that the blood contains abnormal constituents which are the cause of the fever, and that by bleeding we remove some of the obnoxious material. But there is no proof that the poison is in the blood, and if it were there it is of no use to remove a small part and not the whole, and lastly, as specific fevers have a definite time to run, it is bad treatment to deprive them of red-blood corpuscles. The patient will require, perhaps, every drop of blood he has to carry him through the normal course of his illness. Furthermore bleeding increases the rapidity of the dissolution of albumen, leads to an accumulation of fat, and to fatty degeneration, none of them surely desirable in fever. Thus it seems certain that the harm which bleeding does in this condition far outweighs any good effects it can possibly have.

The withdrawal of blood from the veins is of the greatest value in cases in which either from *disease of the heart itself, or from disease of the lungs, or from impairment of the respiratory movements, blood stagnates on the right side of the heart.* It acts by directly relieving the tension in the over-distended veins and right side of the heart, thereby enabling them to work again properly, and indirectly it increases the oxygenation of the blood, because it accelerates the flow of blood through the lungs. The bleeding must not, of course, be carried to a dangerous extent, nor must it be repeated time after time as was formerly the custom. Often a single venesection will suffice to act like a charm, giving the whole circulatory apparatus a fresh start, and then other treatment can be adopted. (For some excellent cases in point see a paper by Dr. Sutton, *Med. Times and Gazette*, vol. ii., 1869.) The guide for determining whether or not to bleed is the state of the venous system. If the veins are gorged and the patient livid, then the removal of from ten to fifteen ounces, or even more, of venous blood will be of greater use than any drugs. So far from a small pulse being taken as a reason for withholding bleeding, it is an indication for it, because in these cases it shows that not much blood is passing through the lungs, and that the arterial system is, comparatively speaking, empty. From what has just been said it is easy to see that the diseases in which bleeding is likely to be attended with success are *bronchitis and valvular incompetence.* As Dr. Wilks says, "You see your patient sitting up in bed; the face, tongue, and lips blue or purple, and the jugular veins starting out of the neck, and often visibly pulsating; the heart beating quickly and perhaps a tricuspid bruit indicating the gorged right heart and obstructed lung; the veins in the body are full to bursting." Many of us must have seen cases recover after bleeding and react to digitalis when before venesection the drug was powerless. The resulting benefit quickly follows, the patient directly loses his lividity and passes into a quiet sleep. It must not be concluded that bleeding is called for in acute pneumonia; in this disease the venous distension is seldom excessive, we know that pneumonia has a definite time to run, and that the patient, in order to have strength to keep going till the crisis, will need all his blood. The only justification for it is in the rare cases in which there is great lividity and venous engorgement.

Bleeding was formerly looked upon as a sheet-anchor in diseases of the brain. Many of these disorders received names then which we do not now recognise, and it is difficult in reading the accounts of them to determine to what maladies they would correspond in our classification. In meningitis bleeding is generally held to be inadmissible as in other inflammations, but as recently as 1880 it was strongly recommended by Sir William Aitken in his *Science and Practice of Medicine:* nevertheless the general opinion is decidedly opposed to its employment. Much has been said about venesection in apoplexy, but the occasions in which it is justifiable are rare, for we must recollect that the patient has already bled into his cerebral substance, so that it would, generally speaking, be foolish to actually increase his loss of blood. The only cases of apoplexy for which it is advisable are those in which there are at the same time some lividity and engorgement of the right side of the heart. Gowers (*Diseases of the Nervous System*, vol. ii. p. 379) gives as additional signs a regular, strongly acting heart and an incompressible pulse. But we must always remember that there are conditions such as embolism and thrombosis, which are difficult to distinguish from cerebral hæmorrhage; in these bleeding would be distinctly harmful, so that it will, as a rule, be better not to bleed the patient unless it appears absolutely necessary. Our chief aim should be to keep him absolutely quiet. A watery purgative capable of acting promptly, such as jalap or calomel, should be given. It probably acts by withdrawing blood from the brain to the capacious vessels of the abdomen, and also by diminishing the blood-pressure for a short time, because of the considerable passage of fluid from the vessels to the interior of the intestine.

In *epilepsy*, when the lividity is very great, as it is sometimes in the status epilepticus, venesection may relieve the patient, as the following case of Dr. Wilks's will show: "We were informed that he had never been out of a fit for four hours. We found him lying in bed with constant convulsive movements, but the most striking condition was the engorgement of his lungs, his labouring heart, and increasing lividity of the surface of his body. I requested that he should be bled. The blood poured out in a torrent, the face rapidly became pale, the man opened his eyes, and spoke for the first time since the morning, the interval having been a blank to him." Nothnagel also makes lividity the criterion for bleeding in cerebral disease. The notion is still prevalent among the laity that any "fit" should be treated by venesection; but we need hardly say that this is not the case.

It is said to be of great use in sunstroke, but many physicians who have had large experience are strongly opposed to its employment.

Some patients suffering from *uræmic poisoning* are certainly temporarily relieved by bleeding, but it is difficult to give a reason for the improvement. Dr. Carter thinks it is due to the removal with the blood of some of the poison; whether or not this is so there is no evidence to show. I never saw it avert death, but this may be because I have not employed it save in severe cases. I have however seen the patient recover consciousness and speak for a few hours.

Sufferers from an *intrathoracic aneurism*, in whom pain, general distress, or lividity is a prominent symptom, may often be relieved for a time by bleeding. The mode of production of these symptoms is not always the same, and it is not therefore easy to say how venesection acts, but I have seen a man whose last days would have been a prolonged agony invariably relieved whenever he was bled.

We must not forget that the very old, the very young and the feeble, bear venesection badly. It should be ascertained that the patient is not anæmic from any cause, that he is not of the hæmorrhagic diathesis, and does not suffer from aortic regurgitation.

The person about to be bled should be propped up. Either the bend of the elbow or jugular vein is the best place to choose for operation, preferably the former.

A bandage should be tied round the arm above the elbow tightly enough to compress the veins, but not so as to obstruct the artery. The patient should grasp in his hand something upon which he can open and shut it, for these muscular contractions will aid the flow. The vein selected should be the most prominent one at the bend of the elbow. It should be steadied with the thumb of the left hand which is holding the arm, and a cut with a lancet must be made into its cavity parallel with its long axis. Some vessel ought to be placed under the elbow to catch the blood, and when sufficient has been drawn the hæmorrhage can be stopped with a pad and bandage. Care must be exercised not to wound the brachial artery.

Arteriotomy is never practised now, so I have made no reference to it.

The application of *leeches* is a method of local blood-letting, formerly much used in cases of local inflammation. Broussais is said to have used as many as 100,000 a year in his wards. They are usually applied near the diseased part, as for example behind the ear in cases of inflammation of the tympanic cavity, and such a spot should be selected that the superficial vessels from which blood is withdrawn are in direct communication with the inflamed part, for it is supposed to be an advantage to withdraw blood from inflamed structures, and certainly local inflammation may often be alleviated by leeches. The spot to which they are applied ought to be well washed, and if they do not at once bite they may be tempted to do so by pricking the part, or by putting a little milk on it. They should not be removed, but left till they fall off. Afterwards the bleeding will often go on for a short time, and occasionally there is some difficulty in stopping it. They are now most used in ophthalmic and aural practice. They will be found to be of value when patients will not allow themselves to be bled from the arm, but will permit the application of leeches; cyanosis however cannot be nearly so well combated by this means as by venesection.

Wet cupping is a means of local blood-letting not now used.

Dry cupping is a simple procedure, requiring a little knack. A glass bell is taken, into it a piece of lighted paper is put; directly the paper goes out, while the air in the bell is still expanded, it is put firmly upon the desired part of the skin. As the expanded air cools and contracts, the skin under the bell swells considerably to fill the partial vacuum created in the bell. By this means fluid is withdrawn from neighbouring tissues. Dry cupping is principally applied to the loins for nephritis. Other remedies are usually employed at the same time, and it is therefore difficult to estimate the value of the cupping, nor is it easy to see how organs so deeply placed as the kidneys, and having an independent blood supply, can be influenced mechanically, although they may be reflexly.

Quite recently Dr. E. Haffter (*Correspondenz-Blatt f. Schweizer Aerzte*, August 5, 1888, p. 515); Dr. Sweetman (*New York Med. Journal*, December 17, 1887); and Dr. Walford (*Brit. Med. Journal*, November 24, 1888, p. 1159), have advised that when we wish to produce the effects of bleeding, a simpler means than venesection is to place a ligature, preferably an indiarubber one, round a limb, so as to prevent the returning venous flow, but it is not to be sufficiently tight to obstruct the arterial stream.

Transfusion will be found described in all books on operative surgery or midwifery.

For further information consult :—

(1) Jürgensen. *Antiphlogistic Methods of Treatment.* Von Ziemssen's *Handbook of General Therapeutics*, vol. ii. *Lond.*, 1885-86.
(2) Marshall Hall. *Researches Principally Relative to the Morbid and Curative Effects of Loss of Blood.* *Lond.*, 1830.
(3) Hayem. *Leçons sur les Modifications du Sang.* *Paris*, 1882.
(4) Bertin. "*Saignée.*" *Dictionnaire Encyclopédique des Sciences Médicales*, 3^{e} *Section, Tome vi.*
(5) Markham. *On the Utility of Blood-letting in Diseases.* *Brit. Med. Jour., April* 9*th*, 16*th*, 1859.
(6) Clarke. *On the History of Bleeding and its Disuse in Modern Practice. Brit. Med Journal*, 1875, vol. ii.
(7) Moon. *On Indications and Contra-Indications of Blood-Letting.* *Brit. Med. Joural, Jan.* 15, 1876.
(8) Johnson, George. *A Lecture on the Action of Blood-letting.* *Brit. Med. Journ., Nov.* 7, 1868.

CHAPTER XVI.

ELECTRICITY.

PHYSICAL AND PHYSIOLOGICAL FACTS OF IMPORTANCE IN MEDICINE.

I PRESUME that my readers have already made themselves acquainted with the elements of electrical science, and I have therefore in this chapter introduced nothing more than a brief abstract which is intended to recall to their minds such physical and physiological facts as it is essential for the physician to know. Many details of the construction of instruments have been omitted, because to make the descriptions worth anything more space would be required than could be spared in a book of this size; elaborate figures would be necessary, and small improvements are so frequently being made that the reader will best become acquainted with electrical instruments by seeing them. Nevertheless I have indicated briefly the advantages and disadvantages of each of the batteries commonly used in medicine.

The only forms of electricity usually employed are the continuous, chemical, or galvanic current, and the induced, interrupted, or faradic current. We will first consider the former.

There are a large number of galvanic batteries in the market, all stated by their respective makers to be particularly suited for medical and surgical work. But they all have their defects as well as their advantages, therefore it is necessary in each case to keep clearly before us what the battery is required to do, and then to select that which on the whole is most suitable. The following brief description of batteries indicates the chief faults of each, and therefore shows us which are most convenient for any purpose.

The Daniell Cell consists of a plate of zinc and one of copper immersed in a dilute solution of sulphuric acid. When a wire is attached to the zinc and another to the copper, and these two wires are connected outside the liquid, a current of electricity will flow in the liquid from the zinc, or as it is therefore called the electro-positive element to the copper or electro-negative element; outside the cell the current flows along the wire from the copper to the zinc, and therefore the free end of the wire attached to the copper is called the positive pole or anode, and the free end of that attached to the zinc is called the negative pole or kathode. In other words the negative pole is attached to the electro-positive element and the positive pole to the electro-negative element.

When the current has run for a short time, owing to the decomposition of the fluid by the electricity, hydrogen gas accumulates on the copper and oxygen on the zinc. This is called polarization; as a consequence of it the intensity of the current falls. Many methods have been devised to diminish polarization. The zinc and acid may be enclosed in a porous pot, and the copper placed outside it in a saturated solution of sulphate of copper (Daniell cell). The hydrogen set free in the porous pot passes through it to the sulphate of copper which is decomposed, fresh copper is deposited on the copper plate, and the sulphuric acid formed finds its way back into the porous pot to replace that which has been lost. Polarization is also often diminished by surrounding the electro-negative element (often carbon) by some oxidizing agent, such as bichromate of potash, dioxide of manganese, or nitric acid.

The Daniell cell is very constant; its electromotive force is 1·08 volts, and its resistance 2 to 3 ohms (see p. 229). It is bulky and requires so much attention that it is but little used in medicine.

All cells with only one fluid have another disadvantage besides that of polarization—namely, that chemical action goes on even when the battery is not working; this difficulty is often got over by raising the plates out of the fluid. Instruments of this kind are called plunge batteries. Continuous chemical action is also often diminished by amalgamating the surface of the zinc with mercury.

The Leclanché cell has a rod of zinc for the positive element, and for the negative, carbon surrounded by or mixed with manganese dioxide. The exciting fluid is a solution of chloride of ammonium. For many purposes it is by far the most useful form of cell, as it is cleanly, does not contain any corrosive fluid, requires no skilled supervision, and as no action goes on when it is out of use it is especially adapted for medical work which is intermittent. It should last at least two years without being recharged. Forty (No. 3) cells are sufficient for all medical purposes. The defects of it are that it polarizes rapidly; its electromotive force is variable; in the small medical cells, if they have not been well coated with paraffin, salts are apt to creep out and spoil them; and lastly, when a Leclanché cell requires repairing, it is an expensive matter, as it must be sent to the instrument-maker, and often the result is very unsatisfactory. The electromotive force is 1·48 volts, and the resistance 3 to 5 ohms. The cells may from carelessness be ruined in a few hours if they are short circuited, that is to say if the current is allowed to run through a very low resistance, as may happen if the electrodes are left in contact with each other, or if the button of the current selector be left in contact with two cells.

Bichromate of Potash Cells.—There are numerous modifications of these. The elements are zinc and carbon immersed in a solution of bichromate of potash mixed with more or less sulphuric acid. Their advantages are their high electromotive force, 1·8 volts or more, and their low internal resistance, but these advantages are for many purposes counterbalanced by the disadvantage, that when not in use the elements must be removed from the fluid, which stains and is corrosive. Most of them are one fluid cells, and they therefore polarize rapidly, especially if their plates are small. The most convenient forms are Grenet's bottle bichromate battery and Reininger's plunge battery.

Stöhrer's battery, which has zinc and carbon elements in a solution of sulphuric acid and sulphate of mercury or bichromate of potash, is a very useful one. Its electromotive force is 1·8 volts, and its internal resistance varies from ⅓ to 2 ohms.

Bunsen Battery.—In this the porous pot contains sulphuric acid and zinc, and the outer vessel nitric acid and carbon. Its electromotive force is 1·93 volts, and its internal resistance 0·25 ohms. The objections to it are that it must be refilled every time it is used; that it is cumbersome, gives off nitrous acid fumes, and is expensive to work; but it is the best battery for heavy cautery work (see p. 237).

There are many other forms of battery, but probably they are not so satisfactory as those just mentioned. Both the chloride of silver and the small sulphate of mercury cells are portable, but the former are dear, and the latter are very apt to spoil from the creeping out of the salts. In any battery secondary currents are developed in it as a result of the decomposition which takes place, and therefore its electromotive force is not constant. This has been used as an argument against the attempt to employ batteries in medicine for quantitative purposes, but the current is never run for more than ten or fifteen minutes, and for so short a time most batteries are sufficiently invariable.

The faradic or induced current has now to be considered. It is often referred to as the secondary current, but this is a term which it would be wise to discard.

The faradic current developed by a revolving magnet is nowadays so rarely used in medicine that we need not refer to it.

The form of faradic current employed is always developed in a coil of wire called the secondary coil, by passing the current from a galvanic battery through another coil called the primary coil, which is near to the secondary coil, and usually inside and concentric with it. A bar of iron, or bundle of soft iron wire is generally introduced into the centre of the primary coil, for as soon as the current passes the iron becomes converted into a magnet, and as such has the power of intensifying the action of the induced current. It is to be particularly remembered that an induced current is not developed except when the primary one is made or broken, or its strength is altered. When the primary current is suddenly closed the induced current is in the reverse direction to the primary; when the primary current is suddenly opened the induced current is in the same direction as the primary. The current induced by a break in the primary circuit is so much more powerful on the human body than that induced when the current is made, that the former is usually intended when we speak of applying the faradic current. Induced currents are also developed in the primary coil, but they are not used in medicine.

All the faradic machines in ordinary use are provided with an apparatus for rapidly making and breaking the current. The means used to vary the strength of the induced current are to alter the distance between the primary and secondary coils, to partially cover the magnet with a copper cylinder, or to take more or less wire of the secondary coil into the circuit. Inasmuch as wires of a large diameter conduct better than those of a small, the primary coil is usually of thick wire, whilst in order to get as many turns as possible the secondary coil is much longer and of thin wire.

The following terms require a few words of explanation :—

Electrodes.—These are instruments by which the current is applied directly to the body : one is connected with the positive pole of the battery and one with the negative. They are of very various forms and sizes, which will be referred to presently. When used for the skin they generally consist of a metal plate with a piece of sponge fastened on it, or some other arrangement of metal that admits of a sponge or wash leather being easily attached to it. Very often it is useful to be able to tell without looking at the battery which is the positive and which is the negative electrode. This can be done in any of the following ways :—

(1.) If they are both inserted in a vessel containing salt and water the kathode is readily distinguished because the hydrogen bubbling from it is twice as much as the oxygen coming from the anode.

(2.) If a piece of moist blue litmus paper is placed in contact with the electrodes and the current is passed through it the blue colour becomes red in the neighbourhood of the anode.

(3.) The kathode applied to the skin causes a more powerful muscular contraction and more tingling than does the anode.

Rheophore.—Some authors use this word as synonymous with electrode, others employ it to designate the wire which connects the battery with the electrode. This wire should be of copper, very fine, and well insulated.

Commutator.—This word is applied in medical electricity to an arrangement introduced into the circuit close to the battery. By means of it the current can be quickly reversed in that part of the circuit which is beyond the commutator, so that the positive electrode becomes the negative and *vice versa.* The instrument must be so constructed that a simple make and break can be made without necessarily reversing the direction of the current.

Galvanometer.—This is an instrument for measuring the strength of the current. The standard of strength in medical electricity is a milliampère (MA.), that is to say the thousandth part of an ampère, which is the unit of strength employed among electricians generally. An ampère is the strength of current due to a unit of electromotive force (one volt[1] as it is technically termed) when the current is made to overcome a unit of resistance, or one ohm[2] as it is called. In medical electricity a current is therefore said to have a strength of ten, twenty, or any other number of milliampères.

It is but recently that the difficulties in the manufacture of galvanometers have been sufficiently overcome to enable makers to turn out, at a reasonable price, an instrument delicate enough to register currents in milliampères. It is necessary for our purposes that it should be portable, fairly strong, and that the needle should come to rest quickly. The galvanometers of Edelmann, Schall, and Gaiffe best meet these requirements. They are very rarely required for treatment, but are used for electrical diagnosis and electrolysis. They can be provided with shunts, so as to enable them to register currents from 1—30 milliampères (MA.), or from 10—300 MA. It is better however to use different instruments for these two purposes, as the passage of strong currents often invalidates their accuracy.

The results given by a galvanometer are only approximate, because a large amount of the current is diffused before it reaches the small nerve or other structure which it is desired to affect: it is also impossible always to have the electrodes precisely over the part which we wish to influence, and lastly the thickness of the skin and subcutaneous tissues vary in different persons. But in spite of all these sources of error, a galvanometer is essential for accurate diagnosis, because it is the only means we have of telling the strength of the current; it is sufficiently accurate for most medical purposes, and an approximate result is better than none at all.

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[1] A volt equals 10^8 units of force, the unit of force being the amount required to raise one gramme through one centimetre in one second.

[2] An ohm equals 10^9 units of force.

The size of the electrodes has an important bearing upon the density of a current. Thus the effect of a current of ten milliampères upon a part under the skin differs when the area of the electrode in contact with it is one square centimetre from the effect when the area is five square centimetres, for in the latter case the area of diffusion will be much greater. C. W. Müller proposes to estimate the density of a current which enters the body by a fraction, the numerator of which shall be the strength of the current in milliampères, and the denominator the area in square centimetres of the electrode applied at the point of entry of the current into the body. It would be well if there were among electricians a standard area for an electrode, but anyhow each experimenter will find it a great advantage, as far as possible, always to use one of the same size. It is doubtful whether the difference of the density of the current is exactly proportionate to the variation in the area of the electrode.

Rheostat.—This is an instrument by which more or less resistance can be introduced into the circuit at the will of the operator. It is not often used in medical electricity, but has been employed for batteries in which all the cells are in circuit at the same time, for by using it, the excessive strain which generally falls on the first few cells is equally distributed over the series. It is found that when this arrangement is adopted, galvanization is more painful than if a current of the same strength, but produced by a smaller number of cells without a rheostat, were employed. It is, however, absolutely necessary to use a rheostat for electric lighting, or for the electro-cautery, to prevent the overheating, which may otherwise readily occur.

Collector.—This is an arrangement by which we can throw into, or take out from the circuit more cells, thus making the current stronger or weaker as we please. Most collectors are so arranged that if a battery, for example, contain thirty cells, and it be required to produce a current with five cells only, the first five will be the cells always employed. There is however an improved form which allows the number of cells required for a weak current to be selected anywhere in the series from the first to the thirtieth. This prevents an undue amount of work being frequently thrown upon the first few cells.

Accumulator.—This, which is sometimes called also a secondary battery, can be charged with electricity by a dynamo or some form of galvanic battery. Hitherto it has been incapable of retaining its electricity for long, but when this difficulty is overcome, it will be most useful for electric lighting and the cautery, as it does not polarize.

Ohm's law is of the greatest importance. It is that the strength of the current varies directly as the electromotive force producing it, and inversely as the resistance it has to overcome. Putting C for strength of current, E for electromotive force, and R for resistance, the law may be expressed thus $C = \frac{E}{R}$. The electromotive force depends upon the means used to produce the current, that is to say, upon the nature of the fluids and substances used, and is said technically to be the difference in potential between the potential of the electro-positive element and that of the electro-negative element. The size of the cells does not influence the electromotive force. If they are arranged in a series it is directly proportional to their number, provided that they are all alike. With the faradic current it is dependent upon the number of turns in the coil, and the power of the central magnet.

Resistance is of two kinds, that inside the battery and that outside. Let us consider the external resistance first.

It has been proved that the resistance of any substance depends upon its temperature, its form, and its nature. The variations due to temperature are not usually regarded in electro-therapeutics or electro-diagnosis. The resistance varies directly as the length, and inversely as the square of the sectional area of a conductor. The nature of the substance is of the greatest importance; the resistance of silver is very small, that is to say it is a good conductor, copper is the best available for ordinary purposes. Liquids are very poor conductors, thus the resistance of distilled water absolutely pure is about 6,000,000,000 times that of chemically pure silver, but is much diminished if the least trace of salts or dilute acids be mixed with it.

The conductivity of animal tissues depends on the amount of water in them, therefore they may be looked upon as saline solutions. Muscle is said to be the best conductor in the human body, and like nerve offers a much greater resistance to currents passing through it transversely than it does to those which traverse it longitudinally.

The horny layer of the skin is an extremely bad conductor; the only conduction it permits is that which takes place through the pores in it, which contain a saline solution, *e.g.* sweat, therefore there is no relationship between the thickness of the skin and its power of conduction. Its resistance is much diminished if it be moistened with warm salt water. The salt, however, has some disadvantages, the worst of which is the chemical effect of it upon the electrodes, consequently some prefer to use plain warm water, for the warmth of the water is far more important than the salt in it, as the contact with the skin will make it faintly acid. A number of cells which will only give a moderate current when the limb is cold give a strong one when it is warm. The resistance of the skin is much diminished towards the end of an application, partly because of the increased hyperæmia and secretion of sweat, and partly because it becomes more thoroughly soaked. It is also diminished on reversing the current several times by means of the commutator, the same number of cells being employed throughout. In one experiment Dr. Pitt found that by this means the amount of current actually passing increased from 1·5 to 6 MA. The resistance at different parts of the skin and in different individuals varies so much that no definite laws can be laid down, hence in many cases it is of great value to arrive at some idea of the resistance by using a galvanometer before we make any experiments. As an illustration of the different conductivity of the skin in different parts, I may refer to an experiment by Dr. Pitt. He found that the same number of cells which, when one electrode was placed on the palm of the hand, produced a current of 1 MA., gave rise to one of 10 MA. when the same electrode was placed on the back of it; the other electrode being in the same position in each experiment.

The accompanying table, drawn up by Dr. Pitt, is instructive.

Muscle tested.	Figures obtained on first application of current. Ten cells always used.		Figures obtained after several reversals of current. The least number of same cells necesary to produce K.C.C. was always used.		
	Resistance of skin & subcutaneous tissues. Ohms.	Strength of current. Milliampères.	Resistance of skin & subcutaneous tissues. Ohms.	Strength of current. Milliampères.	No. of cells used.
Corrugator supercilii	1130	15	2300	1·5	2
Levator Anguli Oris	1420	12	3400	1	2
Flexors of forearm...	3400	5	2430	7	10
Extensors of forearm	4250	4	2125	8	10
Deltoid	2830	6	850	6	3
Biceps	5650	3	4530	3	8
Triceps	11300	1·5	2830	6	10
Abductors of fingers	10000	1·7	4250	4	10
Quadriceps	5650	3	1130	8	12
Tibialus anticus	6800	2·5	990	7	12
Peroneous longus ...	5650	3	1060	10	16
Soleus	5650	3	1090	9	14

The battery used was one of Stöhrer's with an electromotive force of 1·7 volts. The table not only shows the great importance of accurate measurements with a galvanometer, but also the following points:—Firstly, the great differences in the resistance of the skin and subcutaneous tissues in different parts of the body. Secondly, the great diminution in the resistance of the skin and subcutaneous tissues after several reversals of the current. Thirdly, that the number of cells necessary to stimulate different muscles is variable, and consequently that a statement that so many cells were used in any experiment is worth very little. Fourthly, the wide differences in the strength of current necessary to produce contraction in different muscles. Fifthly, the differences in the strength of current sometimes necessary to produce contraction of the same muscle before and after rapid reversals of the current.

Erb gives a striking instance of the poor conductivity of the skin; he says that when the electrodes are placed on the nape of the neck, and in the popliteal space respectively, the same current is felt by the patient to be much stronger than when they are both placed on the shoulder or the lumbar region, where the skin is rather thicker, although the distance of deep tissues to be traversed in the first experiment is more than a metre, and in the second about twelve or fourteen centimetres. Jolly has shown that whilst the resistance on first applying the current is less in the soles than elsewhere, it hardly diminishes during the application, in comparison with the rapid diminution in other parts of the body. We must not forget that the area of the electrode is often of more importance than even the conductivity of the skin.

The resistance of the deeper tissues is slight in comparison with that of the skin, being about 200 times less.

We have now to consider the internal resistance of the battery. It is usual to express the external resistance by r, and the internal resistance by R. Then Ohm's law is thus stated, $C = \frac{E}{r + R}$. Just as a large sectional area of the conductor meant a small external resistance, so a large area of plates means a small internal resistance; but, as we have seen, the electromotive force is not altered by varying the size of the cell. From this it follows that when the external resistance is very great, as in the human body, we gain nothing appreciable by increasing the size of the cell. To take an example, suppose

$E = 10$, $R = 10$, and r, because of the enormous resistance of the human body, equals 10,000, then $C = \frac{10}{10{,}000 + 10}$. If we now take a cell of the same nature, but with plates of ten times the area $C = \frac{10}{10{,}000 + \frac{10}{10}}$, a fraction hardly differing from $\frac{10}{10{,}000 + 10}$; so that we have gained nothing appreciable by increasing the size of the cell. But if, as in galvano-cautery instruments, the external resistance is but small, say for example 10, then by increasing the size of the plates tenfold, we get $C = \frac{10}{10 + \frac{10}{10}} =$ about 1; whilst with the smaller cell $C = \frac{10}{10 + 10} = \frac{1}{2}$, so that we have doubled the strength of the current. Therefore, for the human body it is useless to increase the size of the cells, but it is of use when the external resistance is low.

When a number of galvanic cells are connected together, so that the negative pole of one cell is attached to the positive pole of the next, the electromotive force of the battery will be the sum of the electromotive forces of the cells, because there is a difference of potential at each junction, as the metals are different. Such cells are said to be arranged in a series. To take the instance just given, suppose with one cell $C = \frac{10}{10{,}000 + 10}$, then if we have ten similar cells, we get $C = \frac{10 \times 10}{10{,}000 + 10}$, and thus we see that when the external resistance is large, as in the human body, we can, if the cells are arranged in a series, increase the strength of the current by increasing the number of them, and that the increase is proportional to the number of cells. Further, we learn that in such a case large cells have no advantage over small ones except their constancy.

The cells are said to be arranged in a parallel, or multiple arc, when the positive elements are all connected to one electrode, and the negative to the other. By such an arrangement we really make one cell with both the positive and negative plates increased in area proportionately to the number of individual cells grouped together, and therefore the internal resistance is diminished, but the electromotive force remains the same, so from what we have just said, it follows that nothing is gained by such an arrangement if there be a high external resistance, but only when, as in the galvanic cautery, it is low.

From these considerations we may draw the following deductions:—

For galvanization, whether for diagnosis or therapeutics, we require a battery which will give a current of one to ten MA., through a resistance up to ten thousand ohms. This may be best obtained by from twenty to fifty small cells, arranged in a series. For home work, if the battery is not required to be portable, the No. 3 Leclanché porous pot cells will work well for two years at least. There are many chromic acid and bichromate of potash batteries which also are very suitable. It is always necessary to remove the plates of these directly the battery has been used, and various contrivances, such as corks floating on the solutions and closely-fitting vulcanite lids, have been devised by makers to prevent the fluid from spilling.

For electrolysis, especially for Apostoli's treatment, we require ten to thirty cells connected in a series, with plates of a fair size, so that polarization does not take place too rapidly. The resistance to be overcome is from 150 to 400 ohms, and the current required from 50 to 200 MA. Large Leclanché cells, or Stöhrer's battery answer well; for example, twenty-four cells of the latter gave a current of 150 MA., the resistance being about 250 ohms; in another patient, fourteen cells sufficed, the resistance was then 150 ohms.

For the faradic current, as the primary coil is of low resistance, one to three cells, which do not polarize rapidly are most suitable. They should be arranged in a series. Often a single cell is sufficient. Some form of bichromate battery is commonly used.

For the galvano-cautery we require two to six cells, which have a low resistance (less than ·25 ohm), arranged in a series. The resistance of the cautery is only ·01 to ·1, and that of the wire ·05, hence the external resistance is only ·06 to ·15 ohms, and a current of from 10 to 20 MA. is ample to heat the point or wire white hot. The cells ought not to be too small, lest they polarize too rapidly. This defect may be overcome by connecting them in a multiple arc. The internal resistance may be diminished by increasing the amount of sulphuric acid. For ordinary work, such as the removal of nævi, or operations on the throat, medium or large-sized bichromate cells are the best; but for heavy work, as prolonged operations, during which long platinum loops require to be kept white-hot for many minutes, there is nothing equal to three or four Bunsen cells, for they polarize but little, and their internal resistance is very low. Leclanché cells are less fitted for cautery work, on account of their rapid polarization when working through a low resistance.

For electric lighting for medical purposes, bichromate cells are most useful, as we require a current of one to four MA., constant for half an hour, through a resistance of one to two ohms. Again we may remind the reader that, for both the electric light and cautery it is most essential to use a rheostat, so as to gradually increase the current, for if it is but slightly too powerful, it will fuse the point or destroy the lamp. For these last purposes it is necessary to have large cells, whilst for galvanization, therapeutics, or diagnosis, we must have a number. As it is impossible for one battery to combine both requirements without being unwieldy and expensive, it is essential to have two, if both sorts of work are to be done satisfactorily.

We have already seen that the proportion of the current reaching any point under the skin depends upon the size of the electrode. Suppose we wish as much of the current as possible to reach some small point, such as the motor point of a muscle, which is the spot at which the motor nerve to a muscle enters it (see p. 264); the most advantageous way to attain this is to place a very small electrode immediately over the point, to moisten the skin so that it shall conduct well, and to press the electrode down in order to diminish the distance between it and the motor point. The current then has great density and does not diffuse much before it reaches the motor point. Fig. 10 shows that the greater part of the current from the small electrode A which is well pressed down, reaches the small motor point M in its course to the other electrode B, which may be large and placed at some indifferent point; but had the small motor point been the same size and the same distance under the skin as at N, but the electrode over it large, only a very small proportion of the current would have reached it.

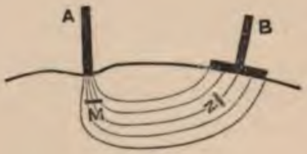

FIG. 10.

If the part we wish to affect is large but not deep down, such as a large superficial muscle, *e.g.* the deltoid, the best way to get as great a proportion of the current through it as possible, is to use two large electrodes placed over it and near together. Fig. 11. shows that if this is done, although the density of the current is not great and its diffusion considerable, a large amount of it passes through the whole of the muscle M. A glance at Fig. 10 will show that had the large muscle been placed in the position of the small motor point M but little of it would have been affected by the current.

If the structure to be influenced is a large one, as the spinal cord, but deeply situated, the best position for the electrodes is as far apart as possible, so long as they are over it, but they must be large. Fig. 12 shows them in this position over a deeply situated muscle M of the same size as the muscle in Fig. 11, and a comparison between the figures makes it clear that if in Fig. 12 the electrodes had been as near together as they are in Fig. 11, most of the current would have completed its circuit without penetrating sufficiently deeply to affect the muscle at all.

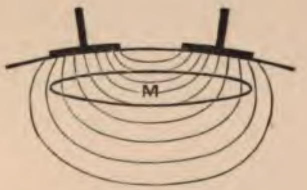

FIG. 11.

If it is possible, as in the case of the head, the two electrodes may be placed opposite each other, and the current sent right through, so that the part we wish to influence comes in the line of it.

Should it be wished to affect the skin, it ought to be well dried, for then it offers so great a resistance that a considerable strength of current may be passed into it without much ever reaching the subcutaneous tissues.

It is well known that electricity has a great tendency to accumulate at points, from which it discharges itself when a considerable collection has taken place. It is this that makes the electric brush, which is an electrode consisting of a number of fine wires arranged like the bristles of a brush, such a powerful means of application.

Static Electricity.—We have no certain knowledge of the value of this in medicine. Dr. Rainey has recently reintroduced it to our notice. In many respects its action resembles that of the faradic current. An abstract of his work will be found in vol. v. of the *Annual of the Universal Medical Sciences for* 1888. In the *British Medical Journal*, September 29, 1888, there is an account of Prof. Lewandowski's new frictional machine, which, according to the inventor, has many advantages over those hitherto used.

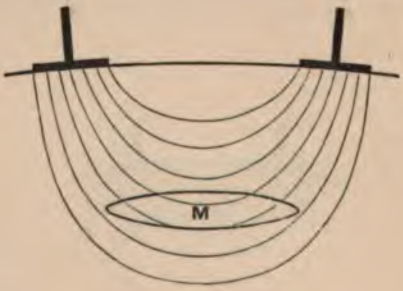

FIG. 22.

Electrical Physiology of Nerves and Muscles.

Motor Nerves and Muscles.—Suppose we pass a galvanic current through a nerve N (Fig. 13), which is connected with the muscle M. It will be found that the condition of the nerve in the neighbourhood of the electrodes is altered, so that in the region on either side of the anode or positive pole the irritability of the nerve is diminished, and in the region on either side of the kathode its irritability is increased. In the region of the anode the nerve is said to be in a condition of anelectrotonus; in the region of the kathode in a condition of katelectrotonus.

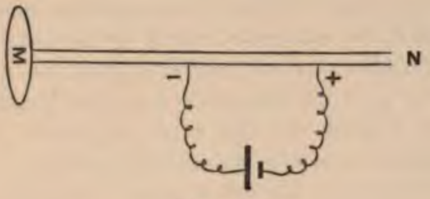

FIG 13.

Between the two poles there is a point at which katelectrotonus merges into anelectrotonus: the altered irritability extends for some distance in each extrapolar region. It is well known that if a current be applied to a nerve which is connected with a muscle, contractions only occur in the muscle, or in other words a nervous impulse is generated, only at the make and break of the current. Physiology teaches us, to quote from Prof. Foster, that "a nervous impulse is generated, at any point of a nerve when there is a sudden change from a phase of lower to one of higher irritability, as from the normal condition to katelectrotonus, or from anelectrotonus to the normal condition. We must however further suppose that the rise of katelectrotonus more readily gives rise to an impulse, or gives rise to a larger impulse than does the fall of anelectrotonus; and that the condition of anelectrotonus especially when pronounced, is an obstacle to the passage towards the muscle of impulses originating on the side away from the muscle."

Let us apply these facts to an explanation of the phenomena observed in man. One electrode is usually placed over the nerve, preferably as near to the muscle as possible, so that the nervous impulses shall not have far to travel; therefore, generally speaking, it is best to apply it over the point at which the nerve enters the muscle or the motor point; the other electrode is placed over some indifferent part, as the sternum. Because a nerve is a good conductor and conducts better in a longitudinal direction than in a transverse, the current will flow some distance along it. Therefore considering only the nerve, we may regard the electrode over it as transferred to a spot on it immediately under the point of application on the skin, and the other pole as transferred from the electrode on the sternum to a point on the nerve at which the current enters or leaves it, and near the sternal electrode. This is seen in Figs. 14 and 15, in the first of which a descending current along a diagrammatic ulnar nerve is shown with the kathode over the lower part of the nerve, and the anode over the sternum. The kathode, as far as the nerve is concerned, may be considered as on its lower part (K), in the figure near the wrist; the anode as on it at the point (A) of entry of the current from the electrode on the sternum. In the other figure the conditions are exactly reversed.

Now if a weak current is employed, on closure of it katelectrotonus is developed at K Fig. 14, and K Fig. 15, and anelectrotonus at A Fig. 14, and A Fig. 15. The nervous impulse generated by the appearance of the katelectrotonus in Fig. 14 being near to the muscle M causes a contraction; but in Fig. 15 it is not powerful enough to overcome the impaired conductive power of the anelectrotonic area, which is nearer the muscle, and there is therefore no contraction. On opening the current, the nervous impulse generated by the disappearance of anelectrotonus, being as we have seen less powerful than

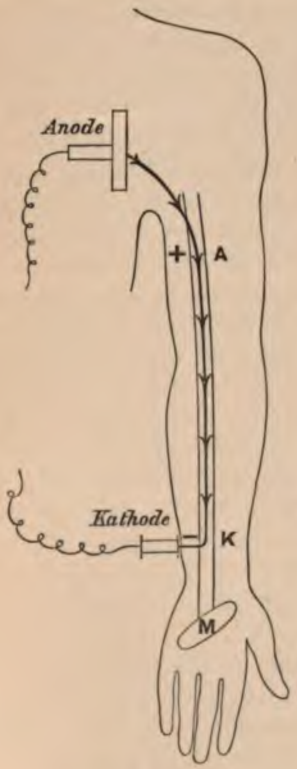

FIG. 14.

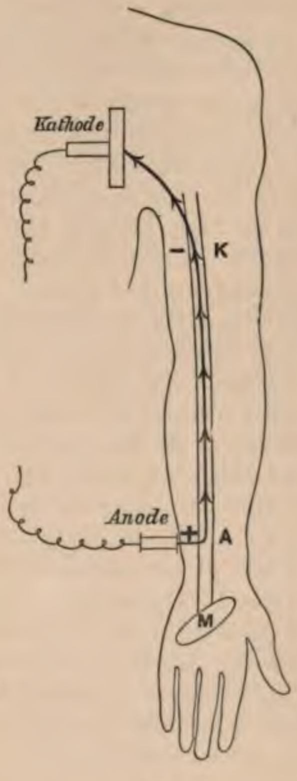

FIG. 15.

that developed by the appearance of katelectrotonus, is not sufficiently strong to cause a contraction; therefore when we close the current, a weak current does not cause a contraction except when the kathode is on the nerve: that is to say we obtain no reaction except a kathodal closing contraction, or K C C.

If the current be medium in strength, on closure of it the nervous impulse generated at K Fig. 14, by the appearance of katelectrotonus, easily developes a contraction, consequently K C C appears readily. In Fig. 15, where the anode is over the nerve, the appearance of katelectrotonus higher up in the nerve generates an impulse sufficiently strong just to overcome the impaired conductivity of the anelectrotonic area, and we therefore obtain a slight contraction on closing with the anode on the muscle, or, as it is called, an anodal closing contraction, or A C C. On opening the current the nervous impulse generated by the disappearance of anelectrotonus is not sufficiently powerful to cause a contraction when the anode is high up in the nerve and the kathode over it lower down, and we therefore get no contraction on opening the current with the kathode on the nerve, or K O C; but when the anelectrotonus is nearer the muscle as in Fig. 15, the nervous impulse generated by its disappearance is sufficiently strong to cause a contraction, that is to say we get a contraction with the anode over the nerve on opening the current, or A O C. As a rule A O C and A C C are obtained by about the same strength of current.

If next we use a strong current, K C C is obtained very easily; A C C and A O C moderately easily; and on opening the current with the kathode over the nerve, the nervous impulse generated by the disappearance of anelectrotonus, although high up in the nerve, is sufficiently powerful to cause a contraction, or, as it is called, a kathodal opening contraction, or K O C. Thus the order in which contraction of muscles can be obtained is

K C C
$\left.\begin{array}{l}\text{A O C}\\ \text{A C C}\end{array}\right\}$ about equal
K O C

and this is called the **normal electrical reaction for muscles** upon stimulation of their nerves.

Anelectrotonic impulses are slower of development than katelectrotonic. Consequently when the make and break are very rapid, as with the faradic current, contractions do not occur excepting when the current is made, and as that takes place very rapidly, the resulting contraction is tetanic.

The above formula with obvious modifications is applicable to sensory nerves as well as to motor nerves.

The galvanic reactions of muscles are probably the same as those of motor nerves, and the faradic current applied directly to muscles causes tetanic contractions oɪ them. The results of the application of both galvanism and faradism to muscles are probably due to the presence of intramuscular nerves.

Sensory Nerves.—The reaction of the nerves of common sensation to the galvanic current is not of much importance in medicine; it is probable, as we just remarked, that the reactions are much the same as for motor nerves. Thus a weak current produces a sensation on closing with the kathode; a stronger current causes anodal closing and opening sensations, and a still more powerful current produces a kathodal opening sensation.

The effects of the faradic current on nerves of common sensation are well known; each make of the current produces a short intense pricking sensation.

If the electrodes are not well moistened, and if the galvanic currents used are at all strong, and are transmitted for some time, a patch of erythema is seen on the skin under each pole, and that which is at the kathode is preceded sometimes by pallor. If the application of the current at the same spot be continued, papules and vesicles are developed, and if it be very strong there is an actual destruction of tissue; a large vesicle forms which dries up, and a scab is cast off, together with the destroyed part of the skin. On the entire discontinuance of the current the ulcer heals, and a scar remains. The vesicles formed at the kathode contain an alkaline fluid, those at the anode an acid liquid. These effects are always much more marked at the kathode than at the anode. When they occur they of course show a faulty method of application. I have seen large sores produced upon a patient who applied the current herself.

Reactions of the Optic Nerve.—The transmission of the galvanic current through the eye always causes sensations of light, different for K C, K O, A C, and A O, and different in different people; but in the same person these varieties of stimulation always produce the same results. Thus in one of Erb's experiments, K C and A O gave a sensation of a blue centre with a yellowish green halo, K O and A C gave a yellowish green centre with a bright blue halo. In this person K C and A O always gave the same results; and K O and A C likewise gave results similar to each other, but different from those produced by K C and A O. These facts have at present no application in therapeutics.

Reactions of the Auditory Nerve.—These were first worked out by Brenner. He originally applied one electrode in the external auditory meatus, which had been previously filled with water; but as this often causes pain, whether or not water is used, Erb advises that a large moist electrode should be lightly placed in front of the ear on the tragus. If both ears are to be acted upon at the same time, a divided electrode must be used. It is convenient for the patient to hold the other in his hand. A divided electrode is something like a binaural stethoscope; the wire from the battery divides into two branches, one going to each ear.

The effects on healthy individuals are that on closing with the kathode on the ear, a sensation of sound is produced by a current of moderate strength; if a stronger one be used the sound is louder, and is described as ringing, buzzing, whistling, &c. On opening the circuit, if the anode is on the ear there is a feeble sound, and kathodal opening and anodal closing give no reaction. If the strength of the current be still further increased, the noise is not only louder, but persists during the first part of the time that the current, with the kathode on the ear, is flowing; at the beginning of the application the noise is loudest, and its diminution is gradual. Putting S for loud sound, s for faint sound, K D for a current of some duration with the kathode on the ear, A D for a current of some duration with anode in the ear, we obtain the following formula with a current of moderate strength:—

K C S
K D S (sound diminishing and disappearing).
A O s
K O (no sound).
A C (no sound).
A D (no sound).

Brenner, Erb, and all observers are agreed that by far the most frequent variation is simple galvanic hyperæsthesia of the auditory nerve, so that K C S equals a very loud noise, K D S lasts as long as the poles are kept in position, A O s becomes A O S; but K O, A C, and A D still give no sound.

In these cases of galvanic hyperæsthesia, when one ear is explored, if the current be strong, and the other ear also hyperæsthetic, it is often found that the ear opposite to the one on which the electrode is placed, hears the same noises which it would if the pole which is in the hand were on it, and the other pole were in the hand. This phenomenon is called the **paradoxical reaction.** It has been, however, simply and satisfactorily explained, in the following manner:—

When the anode is, for example, on the left ear, the kathode, as far as the ears are concerned, is at the nape of the neck, or in other words the virtual kathode is in that position. But the right ear is nearer to this virtual kathode than it is to the anode, and being sufficiently hyperæsthetic to react to this virtual kathode, behaves just as it would if the kathode were applied directly to it (Fig. 16). Thus the reactions are exactly opposite in the two ears; for example, A C causes no effect upon the ear experimented upon, but produces the result of K C or a loud noise upon the opposite ear. It follows from this that, if one ear be hyperæsthetic and the other healthy, currents which are insufficient to influence the healthy ear may produce sounds in the hyperæsthetic ear, even when the electrode is applied over the healthy ear.

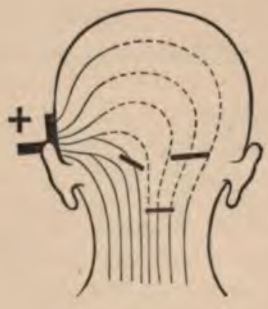

FIG. 16 (*Erb*).

The phrases *galvanization, or faradization of the cervical sympathetic* are often met with, and the directions given for reaching the superior cervical ganglion are to place one electrode between the jaw and mastoid process, and the other on some indifferent point. It is clear that many important structures as the vagus, cervical plexus, &c., would be affected by a current applied in this way, and therefore it is rash to conclude that the results are due to the galvanization or faradization of structures so small and deep-seated as the cervical sympathetic nerve and its ganglia, especially as we have in man so rarely an opportunity of studying the function of the ganglia. It is therefore better to do as De Watteville proposes, and to give up the phrases galvanization and faradization of the superior cervical ganglion, and of the cervical sympathetic cord, and to employ instead those of subaural galvanization or faradization.

For further information consult :—

(1) Erb. *Electrotherapeutics.* Von Ziemssen's *Handbook of General Therapeutics. English Trans., London,* 1885-86.
(2) Beard and Rockwell. *Medical and Surgical Uses of Electricity. New York. 6th Edit.,* 1888.
(3) Ziemssen. *Elektricität in der Medicin. 2nd Edit., Berlin,* 1864.
(4) Rosenthal und Bernhardt. *Elektricitätslehre für Mediziner. 3rd Edit., Berlin,* 1884.
(5) De Watteville. *Medical Electricity. 2nd Edit., London,* 1884.

CHAPTER XVII.

ELECTRODIAGNOSIS.

Electricity is used as a means of diagnosis for revealing the condition of sensory nerves, motor nerves, muscles, and the parts of the central nervous system connected with them.

The following remarks apply equally well to the faradic and galvanic currents. The only suitable method of application is the unipolar. The skin and electrodes at both points of application must be well moistened with warm water. One large electrode, the indifferent one, is applied over the neck or sternum. The other, which should be small, and so shaped (as are, for example, the olive-shaped electrodes) that it can be exactly applied to the desired spot, is placed over the part which it is wished to influence. This electrode is called the exciting one. It would be well if its extremity were of a uniform size as proposed by Erb. In testing muscles it is applied over the spot at which the most lively contraction can be produced; this usually corresponds to the point of entrance of the motor nerve into the muscle. This point is called the motor point of the muscle, and those for the various muscles may be seen on reference to Ziemssen's plates (see p. 264). When this point is found the muscle should be most carefully watched, and the strength of the current necessary to produce a contraction noted. For accurate experiments it is essential that it should be possible to make, break, and reverse the current without removing the electrodes, and therefore a commutator is necessary. Observation is much facilitated if an assistant work the commutator; an arrangement by which the commutator may be worked with the feet is occasionally employed. Conclusions should not be drawn from a single observation, for often the electrode is not at the first attempt placed immediately over the motor point.

If the disease under examination exists only on one side of the body, the healthy side is taken as a standard, but care must be exercised that exactly similar parts are experimented upon on the two sides.

When the disease is bilateral no conclusions as to the diminution or excess of the electrical excitability should be accepted, unless the deviation is very pronounced, for owing to the great variations of resistance in man, it is difficult to obtain a healthy standard. Each observer must, by trying his battery on a number of healthy individuals, find the normal standard of strength required to produce contraction with his own apparatus. This standard will be found to be an average of figures having a considerable difference, so that latitude must be allowed in judging of any deviation.

Quantitative variations of the electro-sensibility of the nerves of the skin are unimportant, and all that need be said about the variations of the reactions of the nerves of special sense will be found in the chapter on electro-therapeutics. We will now treat of some of the modifications of electrical excitability found in motor nerves and muscles.

INCREASED FARADIC EXCITABILITY OF MOTOR NERVES.

This is shown by the contraction of the muscles on the application to the nerve of a current so weak that were the nerve healthy no contraction would be produced, or by a strong contraction being given by a current that usually would only give a weak one. Allowance must be made for variations of resistance. Increased faradic excitability of nerves is rarely met with, but is found as a part of an unusual form of the reaction of degeneration. It probably indicates a very slight lesion of the nerve, sufficient only to increase its irritability. It disappears in from 1 to 4 weeks.

INCREASED GALVANIC EXCITABILITY OF MOTOR NERVES.

We know that this is present when the application of a current to the nerve which ordinarily produces no effect, causes K C C, and a current sufficiently strong to just produce in a healthy nerve K C C, gives rise also to A C C, A O C, and even perhaps a slight K O C. Like increased faradic excitability, it may be found in certain cases of slight neuritis, constituting then part of the reaction of degeneration. The two increased reactions may or may not be associated, and are of little importance unless they form part of the reaction of degeneration, but they have been observed in tetany, tetanus, cramp and a few other obscure conditions.

DIMINISHED FARADIC EXCITABILITY OF MOTOR NERVES.

This is shown by the necessity of a stronger current than usual to produce a muscular contraction.

DIMINISHED GALVANIC EXCITABILITY OF MOTOR NERVES.

This is proved to exist when the strength of current which on application to the nerve is required to produce even K C C, is much greater than usual, and that necessary to cause A C C and A O C is very strong indeed. Diminished faradic and galvanic excitability of motor nerves are usually associated, and will now be described together.

SIMPLE DIMINUTION OF THE EXCITABILITY OF MOTOR NERVES TO BOTH THE FARADIC AND GALVANIC CURRENTS.

This is observed in all cases of paralysis in which its cause is simple destruction of the muscular substance, or of the nerve peripherally to the point of stimulation; for instance, in pseudo-hypertrophic paralysis, and the atrophy of muscles around joints that are fixed by rheumatism, gout, injury, &c. The great value of this diminution will be more evident after we have studied the reaction of degeneration. It also shows, provided its cause is in the muscle, that we have to deal with an organic change; therefore it does not occur in malingering.

In strong contra-distinction stands the reaction in paralyses of cerebral origin; in these affections diminution of excitability is absent, or very slight, even if the case has extended over some years.

In certain spinal maladies as tabes dorsalis, spastic spinal paralysis, and insular sclerosis there may sometimes be a slight diminution, but as a rule there is none in diseases affecting the white matter only.

Lastly, in peripheral neuritis if the nerve be excited centrally to the lesion in it, there will of course be impairment of the muscular contraction whenever the nerve is sufficiently affected to prevent, in some degree, the passage of impulses along it. This fact may be used to determine the position of the lesion in the nerve.

It is of the greatest importance always to make sure that those cases in which the electrical excitability appears to be diminished are not examples either of partial reaction of degeneration or of its late stages, for simple diminution may be, as will be shown immediately, a part of this reaction.

Reaction of Degeneration.

This is an extremely important phenomenon, and is best illustrated by an example. A careful examination of a muscle exhibiting it will reveal the following: For the first few days there is a diminution of excitability to both currents, whether the electrode is applied to the nerve or to the muscle at its motor point. This continues in the nerve, so that soon very strong currents of either kind when applied to it are required to excite contraction, and if recovery does not take place, ultimately no current applied to the nerve, however strong, can cause reaction in the muscle; if however recovery ensues, less powerful currents applied to the nerve are by degrees necessary to excite muscular contraction, till at last a healthy excitability is regained. It is noteworthy that the conductivity of the nerve to voluntary impulses is recovered before its conductivity to electrical impulses, and also that if the lesion be in the nerve, impulses at one period during its repair, can be transmitted to the muscle if applied above the lesion, but not if applied at or below it.

The reaction of the muscle to the faradic current is precisely similar to that of the nerve, disappearing at the same rate, and, if recovery take place, reappearing at the same time. The probable reason for this is, that the stimulus due to the faradic current is so momentary that it does not last long enough to stimulate diseased muscle; and this explanation will hold equally well whether we believe the contraction of a muscle, when an electric current of either kind is applied to it, to be due to the stimulation of the intramuscular nerves or of the muscular fibres themselves.

The result is very different if the muscle be tested with the galvanic current, probably because this form of stimulation lasts much longer than the faradic. When we place one pole on some indifferent part, and the other, the small exciting one, on the muscle, and preferably on its motor point, the following changes in the normal galvanic reactions are observed :—

For the first few days the excitability is slightly diminished; it then becomes greatly exaggerated, so that currents which can hardly be felt readily produce K C C; those which would ordinarily be called weak give the reactions A C C, A O C, and K O C; and the more easily obtained contractions last a long time, so that even mild currents produce, with both the anode and the kathode, contractions having a long duration (Figs. 17 and 18). This is sometimes expressed by saying that we obtain both K D and A D (D standing for duration).

Furthermore, the force of A C C, and the facility with which it is obtained, increase, so that A C C soon equals, and is even greater than K C C, and A D is as easy to obtain as K D, or even easier, both being elicited by mild currents; also K O C is as readily obtainable as A O C, or it may be even more easy to obtain. These curious modifications of the galvanic excitability of the muscle last from three to eight weeks in a case of moderate severity; the exaltation then gradually declines to the normal point, and stops there if recovery takes place. With some patients who recover the galvanic excitability falls a little below the healthy standard for two or three weeks, but it then regains it, and then remains there permanently. If recovery does not follow, the excitability, which may have been exaggerated for as long as forty weeks, declines still further, and after many weeks

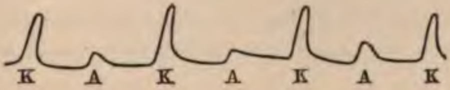

FIG. 17.—A tracing obtained from a normal muscle alternately stimulated to contract by Kathodal and Anodal closures with the galvanic current. It shows the quick strong contractions produced by the former (Erb).

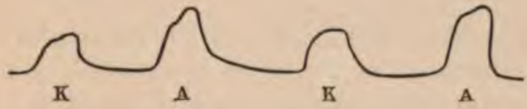

FIG. 18.—A tracing obtained from a muscle showing the reaction of degeneration. Both the Kathodal and the Anodal closing contractions are slow, and the latter are much stronger than the former (Erb).

or months is extinguished. But until the healthy point is reached if the case recover, or until the complete extinction of excitability if it does not, A C C remains more easily obtainable than K C C, and K O C than A O C, so that the last to disappear when restoration to health does not come to pass is A C C, and the contraction produced by it is prolonged and is really A D ; K D also remains until very shortly before the extinction of K C C. Accompanying the reaction of degeneration is an increased excitability of the muscles to mechanical stimuli, the resulting contraction being slow, like that due to an electrical stimulus.

In those cases which recover, slight voluntary power returns at about the same time as the excessive galvanic excitability begins to decline; very shortly after this the reaction of the muscle to faradism and that of the nerve to both currents reappear, and in almost the same length of time as that during which they have been absent, completely regain the usual point.

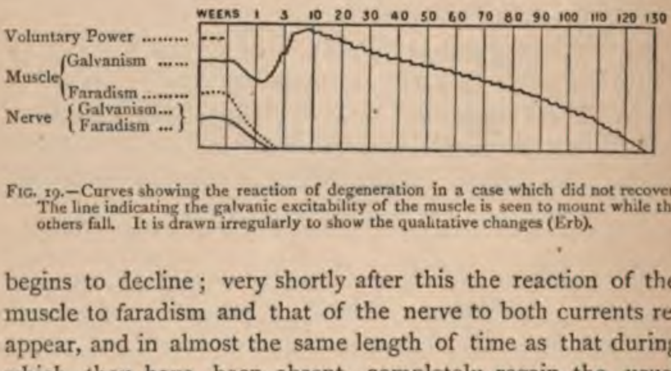

FIG. 19.—Curves showing the reaction of degeneration in a case which did not recover. The line indicating the galvanic excitability of the muscle is seen to mount while the others fall. It is drawn irregularly to show the qualitative changes (Erb).

The contrast between the healthy sequence of reactions and that of a well-marked example of the reaction of degeneration, or R D as it is often called, is shown below. The reactions are arranged according to the ease with which they are obtained :

Normal . 1. K C C. 2. $\left.\begin{matrix}\text{A C C.}\\ \text{A O C.}\end{matrix}\right\}$ 3. K O C.
R D . . 1. A C C. 2. K C C. 3. K O C. 4. A O C.

The reaction of degeneration, or R D, always occurs when the trophic influence of the motor cells, either in the anterior cornua of the spinal cord, or in the nuclei of the cranial motor nerves, is prevented from reaching the muscle whose nutrition they superintend, and never occurs at any other time. Therefore it is observed whenever the anterior cornual cells are destroyed, as in anterior poliomyelitis, or progressive muscular atrophy ; or if there is a neuritis of nerves going to muscles : thus it is present in rheumatic facial neuritis, and in all sorts of peripheral neuritis, whether general, as in alcoholic cases, or local, as that produced by the pressure of tumours, &c. ; and lastly, we find it in cases such as saturnine paralysis, in which the position of the lesion is not always clear excepting that we know it is either in the peripheral nerves or the anterior cornual cells.

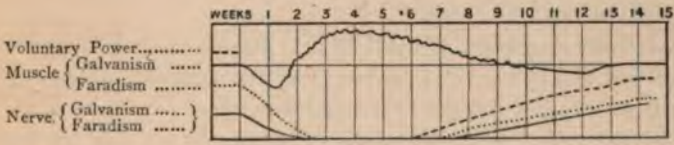

FIG. 20.—Curves showing the reaction of degeneration in a case of recovery in a short time. The line indicating the galvanic excitability of the muscle is seen to mount while the others fall. It is drawn irregularly to show its altered qualitative reactions. It will be noticed that the voluntary power which is the first to return, does so when the galvanic excitability begins to fall, that the faradic reaction of the muscle and both those of the nerve all reappear together, and lastly that the galvanic reaction of the muscle descends a little below the normal line before remaining at it (Erb).

It is well known that all the above-mentioned diseases are characterized by a disappearance of the axis cylinder and a degeneration of the nerve ; at the same time the muscle rapidly degenerates, a process which is accompanied by a multiplication of nuclei in it, although it atrophies. If recovery does not take place, the final stage is the conversion of the muscle into fibrous tissue. R D derives great value from the fact that the diminution of excitability in the nerve is due to the structural changes in it, and that the electrical variations which have been described as discoverable when the muscle is directly irritated by the galvanic current, together with its decreased faradic excitability, are likewise due to the microscopical alterations in it. Moreover, the degree of the diminution of excitability, which constitutes R D as shown in the nerve, is exactly commensurate with the amount of structural alteration in it; and the degree attained by that part of R D which is shown on stimulation of the muscle accurately indicates the extent to which the histological changes have gone on in it. Lastly, the more marked the reaction of degeneration, the worse the prognosis, and *vice versâ*.

Thus the evidence afforded by R D is most exact. It teaches us that the lesion must be either in the peripheral nerves or the motor cells directly connected with them; it shows us the amount of secondary degeneration in muscles and nerves, and it helps us to a prognosis.

It is most important to remember that R D can never be obtained in primary diseases of the muscle, such as pseudo-hypertrophic paralysis; nor in diseases of the nervous system central to the anterior cornual cells, or to the cells of the cranial motor nuclei, such as a tumour of the vertex of the brain; nor in diseases limited to the purely sensory nerves, such as neuralgia of the supra-orbital nerve.

Minor varieties of the reaction of degeneration are often found: sometimes there is an increase of the muscular galvanic excitability, with but a slight diminution of the other reactions. This is probably due to the fact that although sufficient nerve fibres are degenerated to lead to changes in the muscles, some which are healthy are left in the nerve, which consequently responds to faradic and galvanic currents. This is called by Erb the middle form of R D, but Gowers considers it would be better to name it the mixed form. At other times there may be considerable reaction of degeneration with but little alteration in the voluntary muscular power. In certain cases the irritability of the nerve in the first few weeks, is like the muscular irritability, exalted; the exaltation may take place with both the faradic and galvanic currents, but as a rule it is greater with the faradic, and is especially marked with short faradic shocks. This exaltation in the nerves probably indicates that there is but slight alteration in them (Fig. 21).

Rarely the nerve irritability may be increased, with but slight or no affection of the muscular irritability.

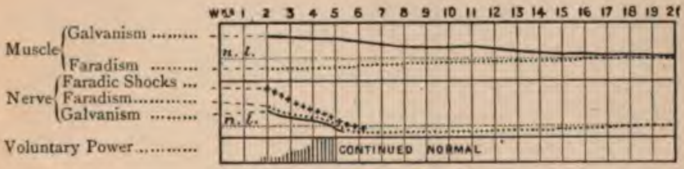

FIG. 21.—Slight neuritis, quick recovery of power during third and fourth weeks. Reaction of degeneration in muscles present at end of second week, slowly lessening, but present in a slight degree until the fourth month. Considerable increase in irritability in the nerve trunk at the end of the second week, greatest to the faradic shock (crosses), and lasting until the fifth week; *n. l.* stands for normal line (Gowers).

I have used the accompanying chart (p. 261) for registering electrical reactions. In front of the letters R and L, which signify right and left, the name of the muscles or nerves tested is written. The reactions obtained are written under their respective columns. Under the head of remarks, observations upon the slowness of contraction, upon the sensibility of the parts, or anything else noteworthy can be recorded. A glance shows whether a reaction of degeneration is present. When filled in the chart may be pasted into the report of the case, and can at a future date be easily compared with subsequent charts. It is here printed half its actual size.

In some books written in the English language, K C C, A C C, are expressed by K Cl C and A Cl C to avoid possible confusion between the two C's. In German books, K S Z, A O Z, A S Z, and K O Z stand for K C C, A O C, A C C, and K O C respectively.

Name ______ *Date* ______ *Disease* ______

	GALVANISM.					FARADISM.	
	Least strength required to produce.						
Part tested.	KCC	AOC	ACC	KOC	Remarks.	Least Strength required to produce Contraction	Remarks.
R							
L							
R							
L							
R							
L							
R							
L							
R							
L							
R							
L							

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CHAPTER XVIII.

ELECTRO-THERAPEUTICS.

THERE can be no doubt that the electric current, when applied to the human body, has various physiological, chemical, and physical effects; but the exact nature of these we are often unable to determine. So little is known about the pathology of many of the diseases that are benefited by electricity, and so little about electricity, that it is almost always impossible to decide in what manner it acts. It will be well therefore if we at once pass to the consideration of some points connected with the methods of application, bearing in mind that the faradic current is more powerfully stimulating than the galvanic, so that when we wish to use electricity as a stimulant we prefer the faradic, but if we desire to obtain its sedative effects we choose the galvanic current.

Much harm is often done by employing too strong a current; especially if it be the faradic. In using large electrodes, unless they are quite flat, the current enters the body at their eminences, where it is very powerful, and hence uneven electrodes produce sores immediately.

Methods of Therapeutical Application.

We have already pointed out that if we wish to reach deeply seated structures, the electrodes should be moistened, and the skin saturated with warm water, in which for some reasons it is an advantage to dissolve a little salt; but if we desire to influence the skin, both the electrodes, or the one which is on the spot to be stimulated, should be dry. If the current be strong this dry application is painful. When the indifferent electrode is moistened, and the stimulating electrode is a dry metallic brush applied upon the dry skin, the arrangement is said to constitute an *electric moxa;* this is a very painful application, sometimes of great service in neuralgia.

Electrodes which are intended to be moistened, should be covered with sponge, flannel, or chamois leather.

From the last chapter we learnt that the most efficient stimulus with the galvanic current is obtained by closing it with the kathode upon the part which it is desired to excite, but that if we wish to decrease the excitability of a nerve or muscle, this can be done by the production of anelectrotonus in it, that is to say by applying the anode over it and closing the current. By taking the anode off the part, and consequently causing the disappearance of anelectrotonus, we stimulate it; therefore it is desirable, if we seek to obtain the sedative effect of the galvanic current by the application of the anode, to discontinue the current gradually, for thereby we avoid the sudden stimulation due to the sudden disappearance of anelectrotonus. The best mode of reducing the current gradually is to reduce gradually the number of cells, by what is called switching off the current, which means slowly diminishing the number by the collector. Indeed, unless very powerful stimulation is required, it is wise not only in this case, but in most others, to make all variations in the current gradually, with a collector. In treating children it is well to begin by placing the electrodes upon the skin, without passing any current, and then slowly to increase it to the desired strength. As a rule faradization should not be employed for children, as it frightens them. It is but rarely permissible to use a current strong enough to cause actual pain. The rapid reversal of the direction of the galvanic current is a powerful stimulus.

1, M. corrugator supercil.; 2, M. compressor nasi et pyramidal. nasi; 3, M. orbicular. palpebr.; 4, M. levator lab. sup. alæque nasi; 5, M. levator lab. sup. propr., 6, M. zygomatic. minor; 7, M. dilatat. narium ant. et post.; 8, M. zygomatic. major; 9, M. orbicularis oris, 10, Ram. comm. pro Mm. triangular. et levator menti; 11, M. levator menti; 12, M. quadratus menti; 13, M. triangularis menti; 14, Ram. subcutan. colli N. facial.; 15, Ram. cervical. pro Platysmat.; 16, M. sterno-hyoideus; 17, M. omo-hyoideus; 18, M. sterno-thyroideus; 19, M. sterno-hyoideus; 20, M. frontalis; 21, Mm. attrahens et attollens auriculæ; 22, Mm. retrahens et attoll. auriculæ; 23, M. occipitalis; 24, Nerv. facialis; 25, Ram. auricular. post. prof. N. facialis; 26, M. stylo-hyoideus; 27, M. digastricus; 28, Ram. buccales. N. facialis; 29, M. splenius capitis; 30, Ram. subcutan. maxill. infer.; 31, Ram. ext. N. accessorii Willisii; 32, M. sterno-cleido-mastoideus; 33, M. cucullaris; 34, M. sterno-cleido-mastoideus; 35, M. levator anguli scapulæ; 36, N. thoracic. post. (Mm. rhomboidei); 37, N. phrenicus; 38, M. omohyoid.; 39, N. thoracic. lateral. (M. serrat. magn.); 40, N. axillaris; 41, Ram. plex. brachialis (N. musculo-cutan., pars N. mediani); 42, N. thoracic. ant. (M. pectorales).

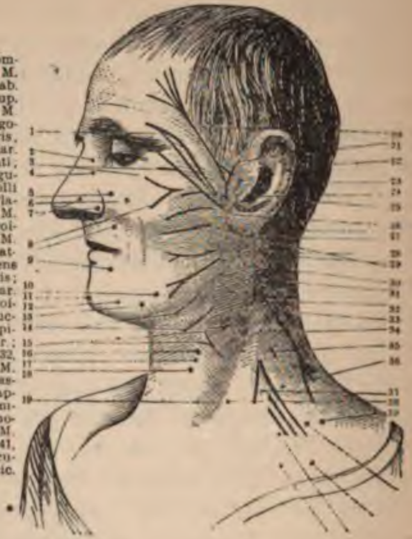


FIG. 22.

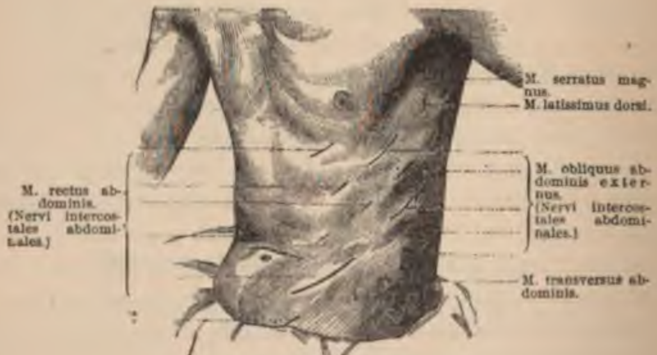

M. serratus magnus.
M. latissimus dorsi.
M. rectus abdominis.
(Nervi intercostales abdominales.)
M. obliquus abdominis externus.
(Nervi intercostales abdominales.)
M. transversus abdominis.

FIG 23

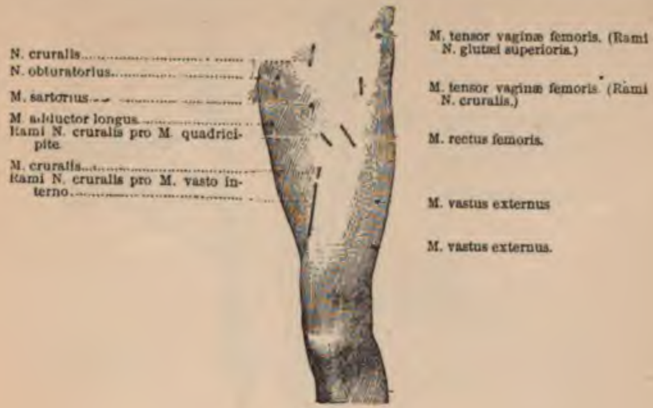

N. cruralis
N. obturatorius
M. sartorius
M. adductor longus
Rami N. cruralis pro M. quadricipite
M. cruralis
Rami N. cruralis pro M. vasto interno
M. tensor vaginæ femoris. (Rami N. glutæi superioris.)
M. tensor vaginæ femoris. (Rami N. cruralis.)
M. rectus femoris.
M. vastus externus
M. vastus externus.

FIG. 24.

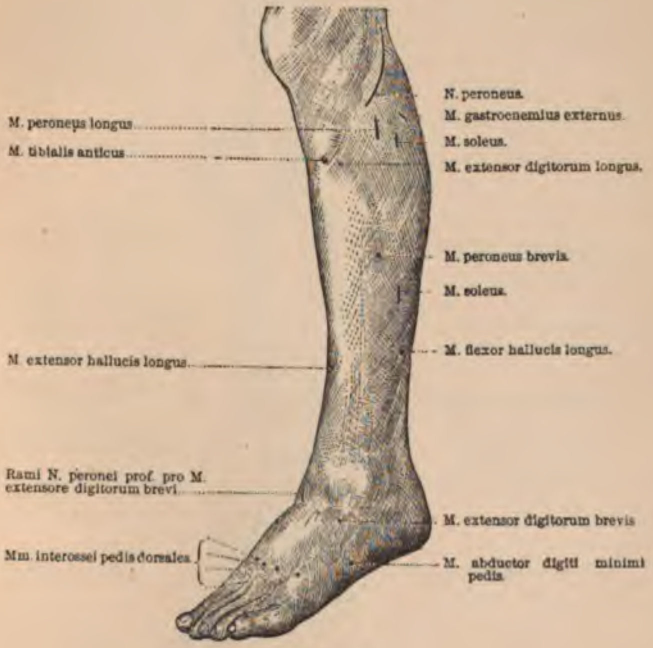

M. peroneus longus
M. tibialis anticus
M. extensor hallucis longus
Rami N. peronei prof. pro M. extensore digitorum brevi
Mm. interossei pedis dorsales
N. peroneus.
M. gastrocnemius externus.
M. soleus.
M. extensor digitorum longus.
M. peroneus brevis.
M. soleus.
M. flexor hallucis longus.
M. extensor digitorum brevis
M. abductor digiti minimi pedis.

FIG. 25.

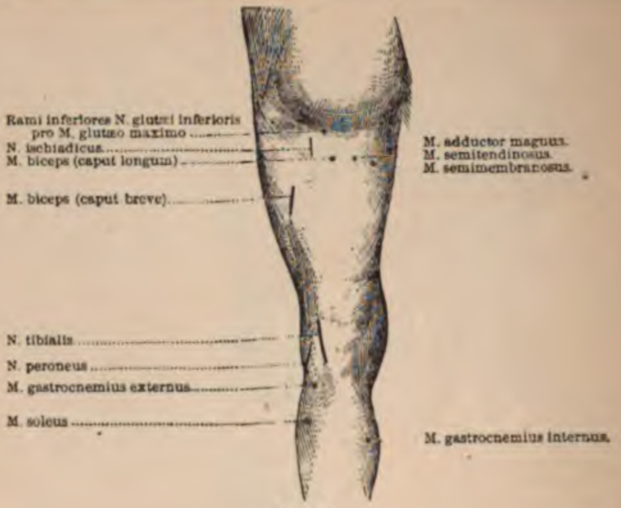

Rami inferiores N. glutæi inferioris pro M. glutæo maximo
N. ischiadicus
M. biceps (caput longum)
M. biceps (caput breve)
N. tibialis
N. peroneus
M. gastrocnemius externus
M. soleus
M. adductor magnus.
M. semitendinosus.
M. semimembranosus.
M. gastrocnemius internus.

FIG. 26.

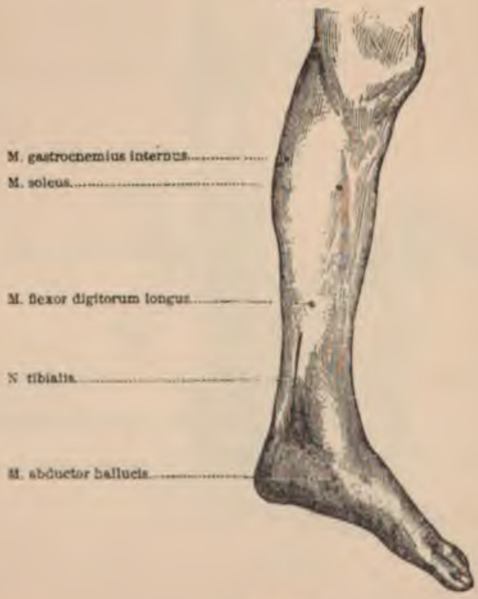

M. gastrocnemius internus
M. soleus
M. flexor digitorum longus
N. tibialis
M. abductor hallucis

FIG. 27.

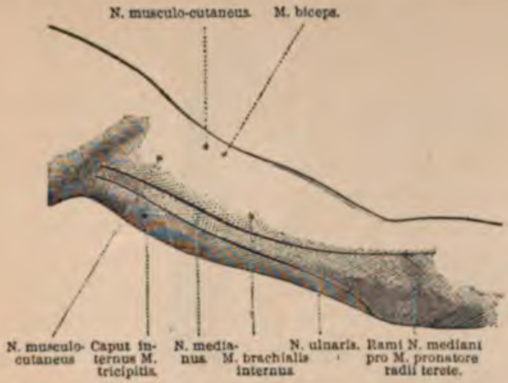

N. musculo-cutaneus.
M. biceps.
N. musculo-cutaneus
Caput internus M. tricipitis.
N. medianus.
M. brachialis internus.
N. ulnaris.
Rami N. mediani pro M. pronatore radii terete.

FIG. 28.

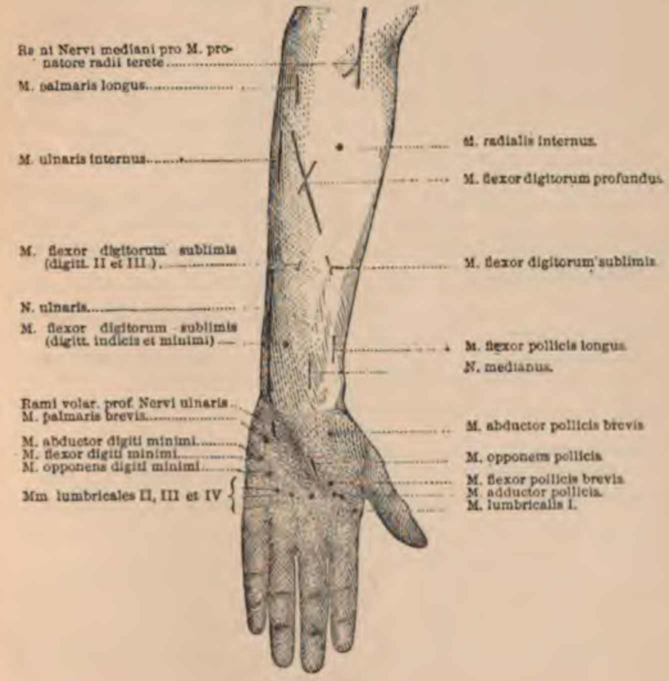

Rami Nervi mediani pro M. pronatore radii terete
M. palmaris longus
M. ulnaris internus
M. flexor digitorum sublimis (digiti. II et III.).
N. ulnaris
M. flexor digitorum sublimis (digitt. indicis et minimi)
Rami volar. prof. Nervi ulnaris
M. palmaris brevis
M. abductor digiti minimi
M. flexor digiti minimi
M. opponens digiti minimi
Mm. lumbricales II, III et IV
M. radialis internus.
M. flexor digitorum profundus.
M. flexor digitorum sublimis.
M. flexor pollicis longus.
N. medianus.
M. abductor pollicis brevis
M. opponens pollicis
M. flexor pollicis brevis.
M. adductor pollicis.
M. lumbricalis I.

FIG. 29.

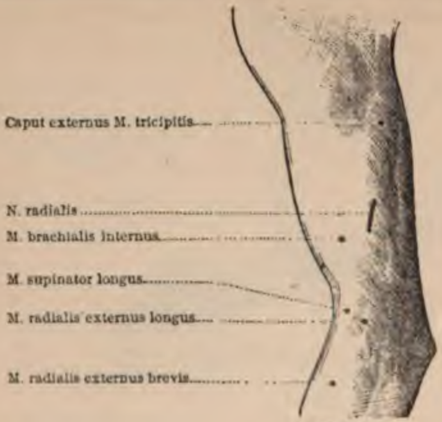

Caput externus M. tricipitis
N. radialis
M. brachialis internus
M. supinator longus
M. radialis externus longus
M. radialis externus brevis

FIG. 30.

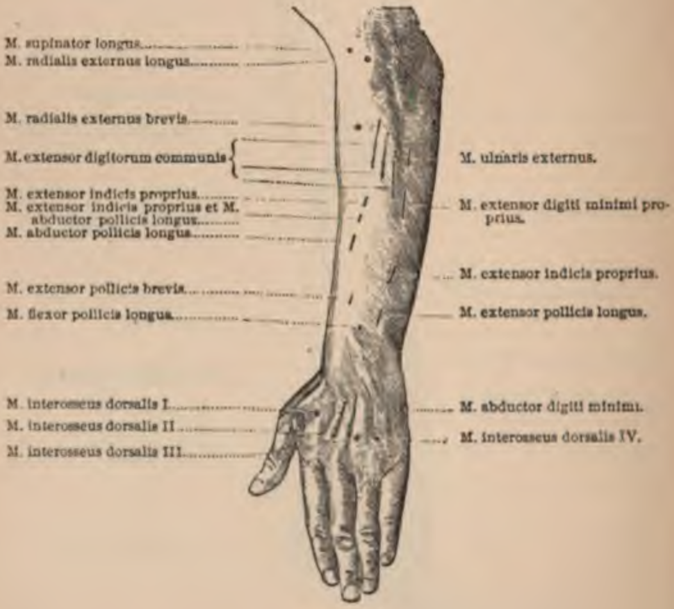

M. supinator longus
M. radialis externus longus
M. radialis externus brevis
M. extensor digitorum communis
M. extensor indicis proprius
M. extensor indicis proprius et M. abductor pollicis longus
M. abductor pollicis longus
M. extensor pollicis brevis
M. flexor pollicis longus
M. interosseus dorsalis I
M. interosseus dorsalis II
M. interosseus dorsalis III
M. ulnaris externus.
M. extensor digiti minimi proprius.
M. extensor indicis proprius.
M. extensor pollicis longus.
M. abductor digiti minimi.
M. interosseus dorsalis IV.

FIG. 31.

The therapeutic application of electricity should be daily, unless the case be chronic, when once every two days will suffice.

When both electrodes are kept in one position during the whole sitting, the application is said to be **stabile**; when one or both are moved about from place to place, although still in contact with the surface of the part to which they are applied the application is said to be **labile.**

Electricity can be applied either locally or generally.

For its local application to muscles it is necessary to know the point at which the motor nerve of each muscle is most easily accessible. These points were first made out by Duchenne and Von Ziemssen, and illustrated by beautiful plates in their works. Ziemssen's figures have been extensively copied, and are sold in the form of a chart, which is very useful, especially when hung up over the battery. The figures are here reproduced on a small scale (see pp. 264 to 268).

To apply electricity locally to these points one large electrode can be placed over some indifferent part as the nape of the neck, or the sternum, and the other small exciting one should be placed over the motor point. Both the skin and the electrodes should be moistened with warm water. If the muscle be large the electrode may also be moved to other parts of it to ensure a contraction of all its fibres.

Either the galvanic or the faradic current may be applied generally. This method has been employed chiefly by Beard and Rockwell, and the following account is taken from their work.

General Faradization.—The object of this is to bring, as far as possible, the whole of the body under the influence of the current. For this purpose one electrode, usually the negative, is a copper plate upon which the patient places his feet, while he sits on a stool. If the passage of the current causes any pain in the ankles he may sit upon the sheet of copper, or the electrode may be a large sponge which is applied to the coccyx. The copper plate should be kept warm by a hot brick under it, and slightly moist. The other electrode is a brass ball an inch in diameter, with a soft wet sponge about six inches in diameter fastened round it. This, unconnected by a wire with the battery, may be held on the patient's body by one of the operator's hands, while the other touches the pole of the battery, so that he becomes the means of transmitting the current. The advantage of this method is said to be that he can readily appreciate, by his own sensations, the strength of the current. But it is not necessary, and the sponge electrode may be connected directly by a wire with the battery. At first a weak current is used, and the strength to be finally adopted is such as will just make it felt, but not painfully. The sponge electrode should be successively brought in contact with all parts of the body, but some, as the head, require weak currents. The back endures stronger currents than any other part. The sponge electrode may either glide over the part (labile application), or be moved from place to place. The length of the sitting should range from five to twenty-five minutes. Beard and Rockwell give the following times of application to each part for a sitting of fifteen minutes: Head one minute; neck, sympathetic, and cervical spine four minutes; back three minutes; abdomen three minutes; upper and lower extremities four minutes. The applications should, as a rule, take place every other day, and the treatment usually ought to extend over a long time. The spinal column, the vertex of the head, the neck, and the abdomen are the most important parts. This mode of treatment is at present chiefly used for cases of neurasthenia, hysteria, hypochondriasis, and nervous dyspepsia; Beard and Rockwell believe that constitutional diseases are better treated by general faradization, and local by local faradization.

General galvanization has been described by these authors.

It is used for the same purposes, and in the same way as general faradization.

Central Galvanization.—This method of using the current was also first introduced by Beard and Rockwell. One pole, usually the kathode, is placed on the epigastrium, and the other is gently passed over the head; a halt of about a minute being made on the vertex. The current should be at first weak, and gradually increased in strength till it produces a sour taste in the mouth. After leaving the head, the electrode is passed down the inner border of the sterno-cleido-mastoid muscle: the application there, on both sides of the neck, lasts from one to five minutes. It is then for about three to six minutes passed up and down the back; stronger currents can be used on the neck and back than on the head. This method is employed when it is particularly desired to influence the central nervous system.

The Electric Bath.—The evidence of the value of the electric bath is not sufficient to make it worth while to describe it here; but some consider that great benefit may be derived from it in chronic rheumatoid arthritis, and general exhaustion.

Galvano-faradization.—This method of application, which has been introduced by De Watteville, consists in uniting the secondary induction-coil and a galvanic battery in one circuit, by connecting with a wire the negative pole of the one with the positive of the other, attaching the electrodes to the two extreme poles, and sending both currents together through the body. De Watteville's experience has been that this treatment is useful for rheumatic conditions and atrophic paralysis, but it needs a more extended trial.

Sub-aural Galvanization.—It has already been mentioned that this term is to be preferred to that of galvanization of the sympathetic in the neck. The operation is performed by placing one electrode below the lobule of the ear, and the other on the nape of the neck. There is no evidence whatever, that by this means the sympathetic is stimulated; in fact, considering its depth and small size, the amount of current that passes through it must be infinitesimal. The faradic current may also be applied to this region.

In the following account of the treatment of disease I have, for the sake of completeness, mentioned many disorders for which electricity is rarely applied. Dr. Pitt has kindly given me notes of some good results obtained in the electrifying room at Guy's Hospital, and I have alluded to them under their respective headings.

Cerebral Diseases,

As we know next to nothing about many of these diseases and about the action of the electric current upon the brain, we cannot explain why some cases are alleviated whilst others, apparently similar, are not benefited by the same treatment; nevertheless the improvement is now and then so marked, that the method is usually worth a trial if other means have failed. The following classes of cases are reported to have been treated with more or less success.

I.—Functional Cerebral Diseases.

Neurasthenia Cerebralis.—I cannot do better than give some examples of the symptoms of patients of this class.

Erb's first case is quoted from Neftel. The patient was a busy physician suffering, in consequence of overwork, from loss of bodily and mental energy; his capability for work was greatly diminished, there were present insomnia, dulness of the intellect, melancholic depression, and inability to work or read, exhaustion, general weakness, and a feeling as of a weight at the lower part of the back. One of Beard and Rockwell's most striking cases was that of an active business man, who had all his life confined himself closely to work. His symptoms were great exhaustion on exertion; he could not read for ten minutes without becoming very nervous, he suffered from insomnia, but had no organic disease.

The method of treatment most recommended by Erb is the application of mild galvanic currents with large electrodes once a day, or every other day, for from one to five minutes. As a rule the anode should be on the forehead, and the kathode on the nape of the neck, but the poles may be reversed; sometimes the current may be sent transversely through the head, or one pole may be placed on one side of the forehead, and the other diagonally on the opposite side of the neck. Beard and Rockwell strongly recommend weak general faradization, one electrode being on the forehead, combined with central galvanization. The latter alone is considered by them to be most suitable for thin persons. Subaural galvanization may be combined with any of these methods, most of which are particularly useful for insomnia. Dr. Pitt has recently had under his care an almost inveterate case of insomnia, which was completely cured by a combination of some of these methods.

Hypochondriasis.—Beard and Rockwell employ general faradization, combined with central galvanization, and record a striking instance of improvement.

Hysteria.—All authors agree that the behaviour of hysteria under electrical treatment cannot be foretold. As it is a general disease, general treatment, such as general faradization combined with central galvanization, is the best method, but often local paralyses will yield to the local application of the faradic or galvanic current. Of all hysterical conditions that of aphonia is most quickly cured by electricity. I have recently had two patients in the hospital, both with hysterical aphonia ; one was completely cured, and the other partially, by the daily application of the faradic current directly to the vocal cords. One electrode is fastened to the sternum or neck, and the other, the laryngeal electrode, is passed into the larynx on to the vocal cords with the right hand, while the mirror is held in the left. Care must be taken to see it in the mirror going well into the larynx, for it is a common mistake to pass it into the depression between the epiglottis and the tongue. When it is in position contact is made and the current passed by pressing down with the forefinger of the right hand a button which is on the handle of the electrode. This may be repeated four or five times at each sitting, which should take place daily. This form of hysteria may also be benefited, but not nearly so rapidly, by placing one pole of the faradic current outside the larynx and the other on the nape of the neck. Often there is a little catarrh of the cords associated with hysterical aphonia ; if this be so, it must be cured before the aphonia will yield.

II.—Organic Cerebral Diseases.

Cerebral Hæmorrhage.—Many authors record good results from electricity in this affection. The treatment ought to be begun about a month after the hæmorrhage, and should consist in the passage, by means of large electrodes, of the galvanic current through the seat of lesion. This may be either (*a*) longitudinal, one pole being placed on the forehead on the same side as the lesion, and the other on the nape of the neck : (*b*) transverse, either pole being on the side of the head over the lesion : or (*c*) oblique, one pole being placed on the same side of the head as the lesion, and the other on the opposite side of the neck ; the current must be weak, and the treatment should last from one to five minutes daily for some weeks. Often, as in some of Erb's cases, the recovery is very rapid. There is no rule as to which pole should be over the lesion; first one and then the other may be tried, and that used which suits best. It is difficult to form an impartial opinion as to the benefit that can be derived, but considering the recorded cases, the treatment seems worthy of a more extended trial than it has received in this country.

Other Cerebral Diseases.—The passage of the galvanic current through the head has been tried in a variety of chronic organic cerebral diseases, such as bulbar paralysis, cerebral tumour, and chronic meningitis; and some remarkable cures have been recorded, but it is always very much open to doubt whether the cases which recovered were examples of the disease which was diagnosed. It is probable that when such diseases really exist electrical treatment is of no use.

Diseases of the Spinal Cord.

Acute Anterior Poliomyelitis.—In this malady the reaction of degeneration of the muscles is of great importance, because if it is slight the prognosis is good, but if it is very noticeable the prognosis is bad. Inasmuch as it is often marked and prolonged, the outlook is usually gloomy.

No electrical treatment should be attempted while the attack is still acute, but at the end of the second or third week it may be adopted in accordance with the general principles we have laid down. If we decide to attempt to influence the cord directly, we pass a galvanic current straight through the diseased part of it, and therefore apply a large electrode over the vertebræ at the point at which the cord is inflamed, and the other, opposite to it, on the front of the body; a moderately strong current should be used, and first the anode and then the kathode applied over the diseased part. This local treatment is not looked upon with favour in England, and Gowers regards it as useless.

The galvanization of the affected muscles is carried out by placing the anode on the spine, preferably over the seat of disease, and stroking the muscles with the kathode, which should be in the form of a good sized sponge electrode. From time to time we may employ closures of the current with the kathode on the muscles. Our object is to preserve them during the recovery of the cord; one result at least of electrical treatment is that the circulation through them is quickened. For some months it should be carried out daily, and afterwards two or three times a week for from six months to a year or more. We have had many cases at Guy's Hospital illustrating the great good of this treatment, and also the importance of steady persistence in it. Erb remarks that the mistake is often made of having the current too strong.

Chronic Anterior Poliomyelitis.—In this disease the prognosis depends much upon the reaction of degeneration. The treatment is the same as that described for the acute form. Recoveries are however said to be much more frequent, but this is probably because many of the described cases are really examples of peripheral neuritis.

Progressive Muscular Atrophy.—Erb lays great stress on the importance of an electrical examination in this malady. The results depend upon its severity, and the stage it has reached. If it be chronic, and is seen early, there are no electrical alterations; if it be rapid there will be reaction of degeneration, which may be nothing more than a simple diminution of excitability to both currents, or the faradic excitability may have completely disappeared, while the galvanic remains, but with the order of the contractions abnormal. Any variations there may be are best seen in the small muscles of the hand, as they are most often affected.

It is doubtful whether electrical treatment is of much use. The same as that advised for anterior poliomyelitis should be employed.

Tabes Dorsalis (*Locomotor Ataxy*).—This disease yields but little to electricity, and it is extremely uncertain whether a cure ever results; sometimes the symptoms appear to improve, but it is difficult to say how far this is due to the electricity, for the intensity of the disease naturally varies much from time to time. Usually it is recommended to apply the galvanic current to the spine, and to treat the leading symptoms without any reference to their pathology, in the same way as will be found described under the headings of neuralgia, anæsthesia, &c. For the pain Dr. Pitt has found it very beneficial to let the galvanic current run, with the anode on the painful spot, and the kathode on an indifferent point, and in one case he considerably relieved the pain by passing a weak galvanic current upwards through the spinal cord.

Other Diseases of the Spinal Cord.—Various diseases of the spinal cord, such as spinal concussion, irritation, and neurasthenia, are occasionally relieved by electricity, but commonly it does no good whatever. Generalization is impossible, each case must be treated by that form of electricity which is found by experiment to be the most suitable. It is best to begin by galvanization of the spinal column, and if that is unsuccessful to try faradization. Frequently cases diagnosed as examples of these diseases are in reality instances of some other affection.

Diseases of the Peripheral Nerves.

This heading includes *multiple peripheral neuritis*, and *local neuritis*, such as that due to injury or pressure. If at all severe it shows the various degrees of the reaction of degeneration. As the peripheral nerves are only an extension of the spinal cord, precisely the same method of treatment as was adopted in anterior poliomyelitis is applicable for them also, so that provided the case has passed the acute stage we use a weak galvanic current and cause the anode to glide alternately over the diseased nerve and the paralysed muscles, the kathode being placed either on some indifferent point, or, following Erb's recommendation, it may be placed over that part of the spinal cord which corresponds to the diseased nerves. Dr. Pitt's experience is that electricity is more useful in this malady than any other.

Paralysis.

Although this is only a symptom, there are many methods of treatment common to all its varieties, independent of its cause, and therefore it is advantageous to consider them together.

Firstly.—We must try to maintain the healthy contractility and irritability of the muscles. To attain this end we should repeatedly stimulate them. The most efficient manner of doing this is to use the galvanic current, placing the kathode on the motor points, and the anode on some indifferent part of the body, and then to rapidly make and break the current. This may be varied by using sometimes frequent reversals of it, or local faradization of the muscles. These various forms of stimulation of the muscles themselves are by far the most efficacious part of the treatment.

Secondly.—The nerves below the lesion should be stimulated in order to keep them functionally active. The galvanic current is the most suitable; the application should be both labile and stabile, and in the course of the nerve.

Any good that may result either to the muscle or the nerve from electricity is probably largely due to the vaso-motor changes induced. Most authorities are content to apply the electricity in these two ways, whatever be the cause of the paralysis; but Erb strongly advocates that an attempt should always be made to reach with electricity the lesion itself. If it be central he does this by applying the current to the injured parts of the brain and spinal cord in the same manner as has been previously recommended for cerebral and spinal diseases. If the lesion be in some position inaccessible to the direct application of the current, he endeavours to influence it reflexly. For example, when the facial nerve within the temporal bone is diseased, he excites the terminal filaments of the fifth nerve on the face with the faradic current, choosing these because when stimulated they cause contraction of the muscles supplied by the facial nerve. The result of this application of the faradic current is that a stimulus passes up the fifth nerve to the cerebral centre, and then reflexly along the seventh nerve to the lesion in it in the temporal bone. When a muscle is supplied by a nerve which is both sensory and motor, and this is diseased in an inaccessible part, such as the sciatic within the pelvis, then the only way of reaching the motor fibres of the diseased part of the nerve is to stimulate the corresponding nerve on the opposite side of the body, for it is known that impulses arriving at the spinal cord by any nerve, often leave it again by the same nerve on the opposite side. If the lesion is in an accessible nerve it is easy to apply either current directly to it, or to stimulate the nerve above the lesion so that impulses may, if strong enough, pass through it.

We will now mention the application of these methods to common paralyses.

Paralysis of the Facial Nerve, the Lesion being in the Temporal Bone.—The most important part of the treatment is, in the manner just indicated, to apply the galvanic current to the nerve and to the paralysed muscles, using chiefly rapid making and breaking with the kathode on them. Occasionally the faradic current may be employed. By these means we endeavour to maintain the excitability of the nerve and the muscles. Next, but it is of much less importance, we may attempt to reach the lesion itself, either directly, by passing a galvanic current through the head from one ear to the other, or reflexly, by stimulating with the faradic or galvanic current the fifth nerve on the face. It is clear that one application will often fulfil several of these ends.

Ocular Paralyses.—The best mode of acting on the muscles directly is to apply the kathode of a weak galvanic current over the closed lids, as near as possible to the insertion of the muscle it is desired to influence, and to apply the anode on the indifferent point. The current should be frequently made and broken. Rapid reversals and faradism may be occasionally used. The nerve cannot be reached directly. If we know where the lesion is we may, if it is in the cranial cavity, attempt to pass a galvanic current through it by placing the electrodes on opposite sides of the head, or if it is in the orbit by placing one on the globe of the eye and the other on the nape of the neck. But it is essential that the muscles should be treated directly. The results must depend entirely upon the cause of the paralysis. At Guy's Hospital most of the cases treated have been instances of cerebral tumour, and therefore no benefit has ensued.

Laryngeal Paralyses.—The only variety adapted for electrical treatment is the paralysis of the adductors met with in hysteria, and this has been considered on page 273.

There is no need to mention in detail many other paralyses, most of which are due to peripheral neuritis (p. 277). In all of them the degree of reaction of degeneration is particularly important for prognosis.

It is a remarkable fact that in *saturnine paralysis*, muscles not visibly paralysed may show a reaction of degeneration, and those which are paralysed occasionally do not exhibit it. There is no affection in which galvanism applied to the muscles is more important than in paralysis due to lead. If subsequent research should show that there is disease of the spinal cord in these cases, it may be well, as Erb suggests, to apply electricity directly to it.

Diphtheritic paralysis is mostly a peripheral neuritis, although sometimes in this malady also probably the spinal cord is diseased. The treatment is the same as in saturnine paralysis, but is not nearly so beneficial. Gowers considers that if it makes children cry much, it is not worth while to adopt it.

Simple Muscular Atrophy.—This is a condition seen in those whose limbs have been kept inactive for a long while. Of course there is never a reaction of degeneration, but only a simple diminution of all electrical reactions. The loss of function of the muscles may be retarded by the application of the galvanic current, making and breaking it with the kathode on the muscle, or by faradism. The mistake is often made of employing too strong a current. The same treatment applies equally well to *pseudo-hypertrophic paralysis*.

Neuralgia and various painful Affections of Nerves.

Our knowledge of the value of electricity in these diseases is very unsatisfactory. Closing the galvanic current with the anode on the part to be influenced, and the kathode on an indifferent spot is known to be sedative and ought therefore to be tried. The current should be slowly switched off as the disappearance of anelectrotonus is an excitant. If the galvanic current is useless the faradic current with one electrode on or near the painful spot may be employed because of its counter-irritant properties. If the seat of the lesion is known the attempt may be made to pass the galvanic current through it. The results are very uncertain : no rules can be given as to the best form of electricity in individual cases. Each must be tried, and that ultimately adopted from which greatest benefit is derived. Cases in which the pain constitutes the whole of the disease are most amenable, and those due to a gross organic lesion are the least.

Erb gives the following as his experience of the value of electricity in the different varieties of *neuralgia :* Mild forms of neuralgia of the fifth nerve are often curable, but severe cases are most intractable ; in fact he says : "I frankly acknowledge that I cannot myself boast of one single brilliant and lasting cure." Cervico-occipital neuralgia is the most easy to cure. The results of the employment of electricity in *migraine* are very unsatisfactory. Cervico-brachial neuralgias are amenable to treatment, as is neuralgia of the lumbar plexus, but intercostal neuralgia is usually rebellious. *Sciatica* can often be cured with galvanism by placing the anode over the most painful part of the nerve, usually the gluteal region, and the kathode lower down over it where the pain is less acute; afterwards other sections of it may be brought under the influence of the current; or the anode may be on the nerve, and the kathode on some indifferent point, as the abdominal wall. The application of the faradic current has often given good results. The sitting should in either case last five or ten minutes.

Gowers, while agreeing in the main with Erb, takes a more hopeful view of the curative effect of electricity in neuralgia, especially in recent examples of purely functional forms, if they are treated by a strong faradic current or by a galvanic current used as a counter-irritant. Great care must be taken to make the diagnosis certain, because, should the case be one of neuritis, harm will be done. If the current be applied as a sedative, the galvanic employed as just directed is preferable, and should be strong enough to be felt but no stronger. If it be decided to try the faradic current as a sedative, it must be very weak and rapidly interrupted, so that its action may as far as possible resemble the mechanical vibration percussion instruments; but if it is used as a counter-irritant it should of course be as strong as it can be borne.

Dr. Pitt tells me that his experience is that it is impossible to say which cases will be cured, and which is the best method, but often those that have resisted all other means of treatment quickly yield to electricity, and this is especially true of sciatica.

Spasmodic Affections.

Again to quote from Erb: "The results of electrical treatment in spasms are in the highest degree uncertain. It can hardly even be predicted, or ever expected with any degree of probability, that a cure will ensue. Sometimes the results are surprising and brilliant; at other times the obstinacy of the affection reduces the doctor and patient to sheer despair."

If in any case, such as one of torticollis, it be determined to try the effects of electricity, it is best to begin with the stabile application of the anode over the affected muscle and its nerve, the kathode being on some indifferent part. Should this fail, other galvanic currents, and then the faradic, may be tried. If any tender spots are discoverable, they must be treated by the application of the anode: frequently this alone cures the spasm. The mistake is commonly made of overlooking some cause which, acting reflexly, sets up the spasm.

Writers' Cramp and other Professional Paralyses.—In the extremely rare paralytic forms the galvanic current may be applied as for other paralyses, and sometimes successfully; occasionally also it is useful for the spasmodic form, and it may be employed as a sedative if there is much pain. Gowers considers that electricity is of but little use in all examples of this group.

Anæsthesia.

The prognosis of this symptom depends upon its origin. As a rule, owing to the fact that a slight cause produces anæsthesia more easily than it produces paralysis, it is more readily cured. The various forms of functional anæsthesia, such as the hysterical, are the most likely to be relieved, and next to these, those due to a slight neuritis. The right treatment is clearly a stimulating one, and therefore the application of the faradic current or the galvanic kathode is to be chosen. Frequently a few applications of the former will quickly cure hysterical anæsthesia. In severe cases the skin may be left dry, and the electric moxa used. If there is much tingling associated with the numbness, symptoms often complained of by women at the climacteric, the galvanic current is indicated.

Diseases of the Eye.

The treatment of the muscles of the eye has been already mentioned, and that for blepharospasmus (spasm of the lid) is the same as for any other form of spasm.

Dor has treated a large number of cases of retinitis and neuritis by electricity. He obtained his best results in those in which optic neuritis developed without any assignable cause; and other authors record a similar experience. The galvanic current should be passed through the temples if both eyes are affected, or from the supra-orbital ridge to the mastoid process if the disease is unilateral; in either case another method is to place one pole—divided if necessary—on the closed lid or lids, and the other on the nape of the neck. Dr. Pitt has had several examples of optic atrophy of obscure origin, which have recovered upon the application of the galvanic current to the eye, and also a few successful cases of retinitis pigmentosa.

With optic neuritis which is part of some other disease, such as that due to cerebral tumour, the prospect is not hopeful. Still electricity is worth a trial, as it is said sometimes to lead to a little amelioration, but I should think it probable that the successful cases were instances of an incorrect diagnosis.

Our facts are not sufficient for us to make any statement about blindness due to tobacco or lead, or about functional amblyopia; nevertheless what little work has been done in this direction is sufficiently encouraging to warrant a further trial of electricity.

Diseases of the Ear.

It is necessary that the reader should fully grasp all that has been said on p. 246 concerning the normal reactions of the auditory nerve.

Auditory galvanic hyperæsthesia is present in many people who have no appreciable disease of the ear, and it is also frequent in all varieties of disorders of hearing. In some aural diseases, not only is there galvanic hyperæsthesia, but any one, or all of K O, A C, and A D may induce noises of various kinds which are often even louder than those produced by K C, A O, and K D, and in extreme cases there may be an actual reversion of the formula, K C, K D, and A O giving no noise, while K O, A D, and A C give rise to loud noises. These alterations of the normal formula are frequently met with in people who suffer from singing and ringing in the ears.

These common and intractable cases are those which are said most often to improve under electrical treatment. The principle is to apply such currents to the affected ear as do not cause any noise. Thus supposing a patient had the normal auditory reaction of K C S, K D S, and A O s, while K O, A D, and A C produced no noise, the correct treatment would be to employ K O, A C, and A D, and after such applications the singing in the ears might be found to be diminished. Again, suppose that the normal reaction has been inverted, and K O, A C, and A D greatly increase the singing in the ears, but K C, K D, and A O give rise to no increase or even to a diminution of the noise, then K C, K D, and A O are the right treatment. Thus the suitable currents can only be discovered after an examination of each case. Most commonly the noise is diminished by A D, and therefore that is the usual treatment. The current ought to be employed with care; it should be gradually increased, and towards the end of the sitting slowly diminished in intensity by means of the collector, for all sudden variations in its strength are very liable to increase the mischief. The electrode should be gradually lifted off the tragus by being drawn over the hair. Usually only weak currents can, at first, be borne, and the patient must become habituated to them before passing on to those which are stronger. The sittings should last from ten to twenty minutes.

The most common effects of the treatment, if it does any good, is for the tinnitus, after the first few sittings, to be lessened for a short time, immediately after the application of the electricity, and from this time gradually to increase till the cure is complete. Erb says that although this treatment is at first ineffectual, nevertheless if, after an interval of six months or so, it be tried again, it may often succeed. There is much divergence of opinion as to its value. In the hands of some aurists no good has followed, whilst others have obtained brilliant results. Dr. Pitt recently had under his care a man who had tried every other means, but was rapidly cured of tinnitus by the passage of the galvanic current through both ears, and at Guy's Hospital we have had several other successful cases.

Exophthalmic Goitre.

Many examples of this disease have been treated by electricity on the erroneous assumption that the lesion is in the cervical sympathetic; and therefore the process incorrectly called galvanization of the superior cervical ganglia has been adopted. Occasionally it has seemed that good has been derived from this plan, and this may be explained by the diminution of the rapidity of the heart's action which, in some persons, follows subaural galvanization, but usually it has been useless. As we are doubtful of the cause of the malady, it is difficult to formulate rules, but the most rational electrical treatment would be that of galvanization of the brain and cervical cord, combined with local galvanization of the thyroid body. Dr. Pitt has recently treated three cases by passing the galvanic current directly through this organ; and in all the pulse has fallen, the flushing and the palpitation have become less, and the patient has felt much better.

Neurotic Dyspepsia.

Beard and Rockwell claim to have successfully treated by electricity this extremely common and intractable disease, which makes the life of those who suffer from it a misery. Inasmuch as neurasthenia is nearly always a complication of this condition, general faradization and central galvanization should be employed; both of these have been already described. Local faradization over the stomach may be used in addition, and according to some authors, it is especially indicated if there be atony, or dilatation of that organ. This complaint has also been treated by passing one electrode into the stomach, and placing the other on the epigastrium; but the experience of most physicians is that electricity holds a very subordinate place as a remedy for *gastric dilatation* in comparison with washing out the stomach. Baraduc recommends that the tube of a stomach-pump should be first passed. The organ is then filled with water, and an electrode introduced down the tube. It is not allowed to quite touch the gastric wall. Whether or not the current causes contraction of the stomach is seen by observing if any fluid flows up the tube. Faradization is usually employed.

Constipation.

This symptom is sometimes only a part of a general condition such as neurasthenia or neurotic dyspepsia; it is then best treated by general faradization, but often it is a malady in itself. The patients have usually been accustomed for years to take strong purgatives, or to use enemata. At last even these fail to produce an evacuation of the bowels. In such cases powerful faradization is most beneficial: one pole, the anode, of large size, is placed on some indifferent part of the abdomen, on the back, or preferably on the flanks, whilst the other, the kathode, medium in size, is passed along the course of the colon, beginning over the cæcum and proceeding in the direction of the ascending, transverse, descending colon, and sigmoid flexure consecutively. The kathode must be pressed deeply; the motor points of the muscles should be at first avoided, the object being to get as much of the current as possible to the intestine. In order to strengthen the abdominal muscles themselves, they may afterwards be faradized with reference to their motor points. Another method is to treat the colon with the faradic current in lengths, by placing first one pole over the cæcum, and another over the hepatic flexure; then one over the hepatic flexure, and one over the splenic; and finally, one over the splenic, and the other over the sigmoid flexure. Lastly, sometimes one pole is introduced into the rectum by means of a rectal electrode, and the other is passed over the wall of the abdomen. Whatever method is adopted the electricity should be applied in the morning before breakfast, in order to secure a healthy action of the bowels after that meal. Each sitting should last five or ten minutes. I have recently had under my care a patient suffering from constipation extending over thirty years, and in whom even enemata failed to produce an evacuation. Abdominal faradization combined with massage completely cured him.

Diseases of the Male Generative Organs.

Spermatorrhœa, impotence, and priapism are often due to disorders of the nervous system, such, for example, as early tabes dorsalis ; their treatment is then that of the malady of which they are a part. Frequently they are associated with general functional disorders, they are said then to yield rapidly to general faradization and central galvanization, but they are often extremely intractable. Local galvanization of the genital organs with a large anode over the lumbar spine, and the kathode passed successively along the spermatic cord, the penis, and the testicles is said sometimes to be beneficial. Whatever method of treatment is adopted it is usually considered to be important that the lumbar spinal cord should be brought immediately under the influence of electricity. Often our chief duty is to prevent patients with these troubles from falling into the hands of knaves who prey upon them.

Paralysis of the Bladder.

The attempt may be made to reach the bladder in the same manner as we saw, when treating of constipation, the intestine could be influenced. Either current may be used ; one pole, preferably the anode, is placed over the lumbar spine, and the other on the perinæum or just over the symphysis pubis.

Some authors advise that a urethral electrode should be passed into the urethra up to the sphincter of the bladder. Another method of application is to place one pole over the symphysis, and the other on the perinæum. Very frequently the paralysis is only a symptom of some disease to which it would be better to direct the treatment.

Nocturnal Incontinence.

This troublesome malady of children is sometimes quickly cured by electricity, applied in the same manner as for paralysis of the bladder. Seeligmüller has reported some very successful cases in which he used the urethral electrode.

Rheumatic Myalgia.

Electricity has been recommended in this disease, and often with good reason. One of the best sedative methods of application is to use a galvanic current, the anode being placed over the seat of pain, and the kathode on some indifferent point. The anode should be moved about on the muscle near the painful spot; towards the end of the treatment some reversals of the current may occasionally be tried, but all variations in its strength ought to be gradually made with a collector. Each sitting should last from five to fifteen minutes. Another method is to employ the faradic brush as a counter-irritant, but this causes considerable pain, and is less efficacious than galvanism.

Artificial Respiration.

The faradic current should be used, and before application it ought to be tested to see that it is capable of producing strong contraction of muscles. Those of the ball of the thumb of the operator form a good test The patient, who is lying down, is firmly grasped by the assistants, who hold his head back steadily in the middle line, draw his tongue out of his mouth, and keep his arms fixed. The advantage of fixation of the arms and neck is that we get firm fixed points for the action of the extraordinary muscles of respiration. The anode is placed on the sternum, and a divided kathode is so bent that each piece of it touches the posterior border of the sternomastoid muscles about an inch from the clavicles, for these are the points of easiest access to the phrenic nerves. This bent electrode is rhythmically applied to these points about seventeen times to the minute. Rather large sponge electrodes should be used, for then, owing to stimulation of the brachial plexus, some of the accessory muscles of respiration are brought into play.

Aneurism.

Although many cases have been treated by the application of electricity, it has not yielded good results. It is for aneurisms of the aorta that it is most often used, but unfortunately the shape of most of them is such that it is hopeless to look for any clotting in them. Many of the recorded cases were unsuitable for treatment; the strength of the current employed, the duration of the sittings and that of the treatment have varied very much; sometimes one electrode, sometimes both have been placed in the sac: consequently no conclusions can be drawn. When the poles of the galvanic current are immersed in blood coagulation takes place at the anode, therefore this pole should be put into the sac, and because a multiplicity of points is an advantage, several wire needles all connected with the anode should be employed. The kathode, a very large electrode, can be placed on any indifferent point. A strong current must be used. De Watteville advises twenty or thirty milliampères for each needle, which should be insulated along its shaft, and have, of course, a sharp point. At the first sitting the current should flow about half an hour, afterwards we must be guided by the results. Great care must be taken to draw the needles out slowly with a twisting motion, so as not to disturb any blood clot. Chloroform is unnecessary, but cocaine may be injected subcutaneously over the aneurism. It is very doubtful whether the method ought to be recommended.

Hydatid Cysts.

The treatment of these by sending an electric current through them by means of a fine needle passed into them, was first brought prominently forward by Dr. Fagge and Mr. Durham. It is not now often used, for it has been found that simple puncture will do equally well.

Electricity is often very successfully employed in medicine for its destructive action.

The galvano-cautery is useful for tonsillitis and granular pharyngitis, but it must be applied delicately, or the area of destruction will be too large. It is also used to burn away nævi, warts, cancrum oris, sloughs, &c.; the only objection to it is that it leaves a scar.

Electrolysis.—A method of application termed electrolysis is employed for several purposes, of which the following are the more important:

Nævi.—A fine needle connected with the anode is plunged into the nævus, the kathode is placed on the skin just outside its margin, and a galvanic current of five milliampères is allowed to run for a minute. This leads to the gradual destruction of the nævus. The number of applications must of course depend upon its size. The advantage of this method is that no scar is produced. A previous subcutaneous injection of a twenty per cent. solution of cocaine will diminish the pain. The skin usually swells up a little after the operation.

Superfluous Hairs.—These may be removed in the same way. A very fine needle connected with the anode is plunged into the hair sac, the kathode is placed on the skin close to it, and a galvanic current of one milliampère is passed for half a minute. Cocaine may be used if necessary. There is no objection to removing as many hairs at a sitting as the patient can, without pain, allow, but it is advisable not to take away at the same sitting a group of hairs close to one another. There is no subsequent scarring.

Strictures of the Urethra, and of the Eustachian Tube.—These have been treated by passing an appropriate catheter insulated except at its point. This is connected with the anode. The kathode is on some indifferent spot, and a galvanic current of five milliampères is allowed to flow for five minutes. We have not yet sufficient evidence before us to show whether this treatment is of any value, for whilst many observers extol it, others say that any good that may result is transitory. At the Meeting of the Academy of Medicine in Paris, on March 13th, 1889, a patient was shown whom M. Fort claimed to have cured of stricture of the œsophagus by electrolysis, used in the same manner as for stricture of the urethra.

Apostoli's Treatment.—This has been used for many conditions, the chief of which are uterine fibroids, sub-involution of the uterus, and dysmenorrhœa.

The apparatus required is a battery of twenty to thirty cells, which will not polarize too rapidly. Stöhrer's battery, or a series of large Leclanché cells, is very suitable. A galvanometer registering from 10 to 300 MA. is essential. The external electrode is formed of a mass of wet artists'-clay enclosed in a piece of muslin, and spread in a layer six or eight inches square over the moistened abdomen, care being taken to avoid hairs, pimples, or sores. On the surface of the muslin is placed a small sheet of copper with binding screws attached to it. A more cleanly but less efficient electrode may be made of fragments of carbon enclosed in a flat flannel bag which is thoroughly wetted. The internal electrode consists of a rod of metal the diameter of a No. 7 catheter. This can be protruded and fixed by a screw at any required distance beyond its insulated sheath. When it forms the kathode it may be made of flexible copper, but when it is the anode the uninsulated portion must be made entirely of pure platinum, otherwise its oxidation causes it to adhere to the tissues, thus leading to hæmorrhage.

The patient is placed at the edge of a couch in the lithotomy position, or on her side, otherwise the internal electrode is apt to catch against her clothes.

The uterus is first measured by means of a sound, then the internal electrode, with its uninsulated part half an inch shorter than the uterine cavity, is passed into the uterus. None of the unprotected part of the electrode should lie in the vagina, although if the uterus be distorted it is not easy to avoid this unless the electrode can be bent. The external electrode is applied to the abdomen. The two are connected by insulated copper wires to the poles of the battery, the galvanometer being in the circuit. The current may be graduated by varying the number of cells employed, or by using a fixed number of cells, and intercalating a variable resistance with a rheostat, but the rheostat is objectionable as it causes pain. The cells are put into action singly until a current as strong as the patient can bear, is reached. The strength is usually less than 50 MA., and even if she can bear it, a greater strength ought not to be used at first, but after a few sittings as much as 150 MA. may be employed. The current is allowed to pass for about five minutes, and is then gradually decreased to zero. It is necessary both to syringe out the vagina with an antiseptic solution, and to thoroughly sterilise the internal electrode before and after the operation. After the application is made the patient should remain quiet during the remainder of the day. The operation should be performed twice a week.

The experience in the obstetric ward at Guy's Hospital is that the hæmorrhage connected with uterine fibroids is sometimes lessened, but in no case has one of the fibroids diminished in size, and in some cases the pain has been so great that the patients have refused to continue the treatment, whilst in others it has caused pelvic cellulitis. Favourable cases have however been reported, but some of them were examples of sub-involution of the uterus, and not of uterine fibroids.

It is usually recommended to use the internal pole as kathode for dysmenorrhœa, and as the anode to check hæmorrhage.

The electrical resistance of the patient will vary from 100 to 500 ohms, and occasionally, if the skin is not thoroughly wetted, to double this number.

CHAPTER XIX.

HYPNOTISM.

ITS MODE OF PRODUCTION, PHENOMENA, AND SUBDIVISIONS.

HYPNOTISM has been used but little for therapeutical purposes in England, at least of late years, but it is at present exciting so much interest abroad that some reference to it is necessary. Many members of our profession have looked upon it as unworthy of attention, and the reasons for this are not far to seek, for it has been made the subject of public exhibitions by obvious charlatans; and those who have devoted themselves to it have coined meaningless phrases such as electro-biology and animal magnetism, which are supposed to explain the phenomena, but are so unscientific that they have repelled persons from investigation. Most of the earlier works on the subject are also so full of rubbish that they quite disgust the reader, and many of their statements are obvious nonsense, such as the ridiculous declaration of Dr. Ashburner that the material force emanating from his own brain enabled him to compel gold to ignore the vulgar laws of gravity. Lastly, even some of the most distinguished advocates of hypnotism have allowed themselves to be deluded into believing all sorts of inaccuracies, as we see in Dr. Elliotson's credence of certain experiments in metallotherapy. Now however that Heidenhain, Charcot, Beaunis, Langley, and other well-known men are investigating the subject, it is worth while to pay some attention to their results.

To give some idea of the interest hypnotism is arousing, I may mention that Max Dessoir's *Bibliographie der modernen Hypnotismus,* published in 1888, contains references to 812 publications, and of those dated, 121 are anterior to 1880, and 688 have been published between January 1, 1880, and April, 1888.

Hypnotism, somnambulism, animal magnetism, and electro-biology are four different terms for the same condition. The last two implying, as they do, that it bears some relationship to magnetism or electricity are, in our present state of ignorance, extremely bad. The phrase artificial somnambulism has been employed as synonymous with sleep-walking, that of induced somnambulism is also used to indicate what is usually meant by hypnotism, and lastly, one peculiar variety of hypnotism is described by the Salpêtrière school as the somnambulistic state; therefore, as the word somnambulism has so many meanings, I shall employ it as little as possible, and confine myself almost entirely to the one term hypnotism.

The word hypnotism is incapable of exact definition. It designates all those conditions resembling natural sleep, but artificially produced without the aid of drugs. A person in any of these conditions is said to be in a hypnotic state or condition, and to have been hypnotized. The operation of hypnotizing is called hypnotization.

Methods of Hypnotizing.

There are many means of hypnotizing, but they all agree in fixing the attention upon one thought to the total exclusion of all others. This is done either by uniform sensory stimulation or by suggestion.

Of all the methods which act by sensory stimulation, the easiest is for the subject to fix his eyes upon some bright object, such as a light, a mirror, or a shilling, which is kept quite still, near to, and a little above him, so that he must converge and turn up his eyes to see it. This was the means employed by Braid. The first person he hypnotized was a man named Walker, whom he made to stare at a wine-bottle placed on a shelf above him. Egyptian conjurors have for many centuries practised hypnotization by making people gaze fixedly at a glittering crystal ball, and Hindoos hypnotize themselves by staring at an imaginary point in space. A finger or any object will often do as well as a light, and a very favourite method is for the patient to be told to look intently at the operator's eyes, the two persons sitting close to, and exactly opposite each other. Beaunis mentions two women who were simultaneously hypnotized by staring at each other. Sometimes the object to which the eyes are directed is not fixed; Mesmer and his followers slowly passed their hands vertically upwards or downwards in front of the subject, and he "was magnetized by passes" as they said.

The attention may be concentrated by stimulation of other senses; thus Charcot often hypnotizes his patients by striking a gong, and with some persons a ticking watch has the same effect. Also the induction of hypnotism by passes may take place even when the passing cannot be seen by the subject. because the operation is performed behind his back; the hypnotic state is then due to the stimulation of the cutaneous nerves caused by the warmth of the hands. This is proved by the fact that it is very difficult to hypnotize people by passes invisible to them, if the hands be gloved. The slight currents of air which are set up by their movements may have some influence. Gentle stroking or touching may also be efficacious, and a favourite method with the early operators was to take the subject's hands in theirs.

The following table, modified from one given by Binet and Féré, summarizes the methods of hypnotization by sensorial excitation:

(1) By excitation of the sense of sight.
  (*a*) Strong and sudden excitement as by sunlight, or artificial light reflected in a concave mirror, or the electric or magnesium light.
  (*b*) Slight and prolonged excitement, as by fixing the eyes on any object for some time; preferably it should be placed above and near to the subject.
(2) By excitation of the sense of hearing.
  (*a*) Strong and sudden excitement, as by a gong.
  (*b*) Slight and prolonged excitement, as by a ticking watch.
(3) By excitation of the sense of touch and temperature.
  (*a*) Strong and sudden excitement, as by pressing over the ovaries in hysterical women.
  (*b*) Slight and prolonged excitement as by passes, by stroking, or by contact.
(4) By excitation of the sense of taste.
(5) By excitation of the sense of smell.

Any of these means operate more easily if the subject is expecting to be sent to sleep.

Often the state may be induced, without any sensory stimulation, by suggesting to the subject that he is about to sleep, and if he is particularly susceptible it is only necessary to stand in front of him, to look at him fixedly, and to say "Sleep." Generally a longer suggestion is required, and the operator has to talk to the subject for some little while and to repeat the word sleep very often, saying for example, "Now you are going to sleep. Think only of sleep. It will come naturally. Sleep. You feel it coming on. The sleep makes your eyelids heavy," and so on, speaking all the time slowly, distinctly, and in a monotonous tone. Several operators intensify the idea of sleep by closing the eyelids. Many subjects are hypnotized instantly, but some require half an hour or more. The Nancy School in particular employ this method of hypnotizing by the suggestion of sleep. If the first *séance* is unsuccessful the experiment should be repeated next day, and it may be that success will come even at the fifth attempt. Some people may be made to pass into the hypnotic state at a specified time after the suggestion. I have seen this myself. The successful instances that Beaunis gives are that the operator says, "I am going to count ten, when I get to six you will sleep," or, "Count to ten, when you get to eight you will sleep," or, "Go to that door, open it, when you have done so you shall sleep." Bernheim states that those who are easily affected can be hypnotized by writing to them, or by telephone. In all cases the idea of sleep is strongly implanted in the subject's mind, to the exclusion of all other thoughts. Persons who are very susceptible need only think that they are about to undergo hypnotization, and they will become hypnotized; thus one may say to them, "You will be hypnotized in five hours," and when the time comes, even if they are alone, they will pass into the hypnotic state.

The duration of the hypnotic state when the patients are left to themselves is very variable, but Bernheim states that the average is four hours. The extremes are, however, so far apart that an average is of but little value.

Geischdlen has shown that it is possible to hypnotize those who are already in a natural sleep, a fact of great importance, for it is very difficult to influence lunatics when awake, but if they happen to be asleep naturally, hypnotization may be carried out quietly.

From the above account the reader is no doubt struck by the ease with which some persons can be hypnotized, but it must be remembered that many people can, at almost a moment's notice, induce ordinary sleep in themselves.

Phenomena of the Hypnotic Condition.

(*a*) *Psychical Phenomena.*—The chief and most common of these is a diminution of consciousness. The degree of diminution is variable. On waking, the subject may remember nothing that has happened, or he may if a hint is given to him, or he may easily recollect it all. During hypnotization he usually reacts to impressions that he receives through the senses, which are often extraordinarily acute, but this reaction is entirely that of an automaton. For example, if any one frequently clenches his teeth before a hypnotized person, he immediately imitates the action, but he also does it, even if he cannot see the operation, provided that he can hear, ever so faintly, the teeth come together. The absence of any voluntary control over the ideas produced leads to the most absurd conditions. Thus we had a girl in Guy's Hospital who could be easily hypnotized; if then she was given a cushion, and told it was a baby, she began to nurse it, tried to feed it, and showed the greatest signs of agony when she was told it was dead. The auditory impressions gave rise to ideas in her to which she reacted although her will had no power to control them. Again, a common experiment is to tell a hypnotized person that there is a lion before him; he flees directly in the greatest terror. One movement of the subject carried out by the operator often leads to all the others commonly associated with it; thus I have seen Charcot place the hands of a hypnotized girl together as in prayer, immediately her eyes looked upwards, the face assumed an air of intercession, and she went down on her knees as if before a figure of the Virgin, although she was in the hospital consulting room. This phenomenon was first discovered by Braid.

When we set up any of these unconscious ideas in a hypnotized subject, we are said to suggest them. Thus in the instances just given it was suggested that the cushion was a baby, and the movement of the jaws was suggested by the sound of bringing the teeth together. The act of suggesting we call suggestion, and we talk of the phenomena of suggestion. The suggestion is usually verbal, but it must not be vague. Heidenhain observed, that when he said to his hypnotized brother, "If I had a watch I should like to see what o'clock it is," no effects ensued. But if he said, "Show me your watch," the order was at once obeyed. With favourable subjects a *séance* can be terminated by suggestion; thus we may say, "You shall wake at 5 o'clock" and it will be so, or, "You shall wake in ten hours," or, "When I count six," or, "When I touch you." If the subject is very sensitive, the merest look or gesture on the part of the operator is sufficient to cause an act to be performed, and therefore suggestion is often accidental. If asked what he is thinking about, a hypnotized person says "Nothing."

It may be well to remind the reader that the phenomena of suggestion exist, although to a less degree, in ordinary life. Saying to a sensitive person, "You are crying," or "You are blushing," will cause these acts, and many of the audience at a theatre weep uncontrollably because the acting suggests that the heroine is killed. Suggestions can also be made to persons who are asleep. When Maury (*Sommeil et Rêves*, p. 127) was asleep, a friend put a bottle of eau de Cologne under his nose. He dreamed he was in a perfumer's shop; scent aroused in him the idea of the East, and he dreamed he was in a shop in Cairo. Then we have the phenomena of auto-suggestion which are of frequent occurrence; for example, many persons can, if they concentrate their attention on their desire, wake at any hour they please. To give an instance, I had to catch an early train. I went to bed at the usual time, saying emphatically to myself I must wake at five; I slept soundly all the night, and woke at five minutes to five.

To return to hypnotism. Suggestions can be made which shall take effect after waking. These are included in the term *post-hypnotic suggestion*. To give some instances, one may suggest that when the subject wakes he shall not see red things, or that he shall be able to see a friend, but not hear him, or even be entirely ignorant of his presence when he is close to him. These last two instances are examples of what is called a negative hallucination. The results appear very curious to the subject, for when objects are shifted about the room by the invisible operator they seem to have the power of spontaneous movement. Post-hypnotic suggestion is largely used by the Nancy school to cure diseases, especially if they are functional, it being suggested to the patient that when he awakes from the hypnotic state he will suffer from none of his previous symptoms. It may be suggested that at some particular time the subject shall do this or that act. Beaunis gives an instance of a woman who acted upon a post-hypnotic suggestion as long as 172 days after it was made. The act can only be performed at the time suggested. To give an example, it is suggested to the subject that at five o'clock the next day he will read page eight of a given book, if it is presented to him at any other time it recalls nothing, but at five he will fetch it, open it at page eight, and read. The impulse to do the suggested acts may be quite uncontrollable, and is always so unless they are extremely repugnant; the deeper the hypnotization the more likely is it that they will be performed. Post-hypnotic suggestions made in what will be presently explained to be the cataleptic state are carried out quite automatically and inevitably, but in the somnambulistic state reason, to a slight extent, controls them. After the completion of a post-hypnotically suggested act the subject generally makes an attempt to find a reason for it; if for example he has been made to strike a bystander he will say, "The villain deserved it." The greatest caution is necessary to prevent deception, and the best instances of post-hypnotic suggestion will be referred to presently under the headings of vasomotor phenomena and therapeutics.

Examples of a state of mind similar to that of a person acting upon a post-hypnotic suggestion are common. For instance the exhuming of the body of a child was ordered. When the coffin was taken up the magistrate present said he could smell the corpse, but the coffin was empty. Here the belief of the magistrate that he did smell the corpse was due to the strong previous auto-suggestion that he would.

Post-hypnotic hallucinations generally disappear slowly. The operator may make several suggestions one after the other, and all will be acted upon, and it is possible successfully to suggest that acts performed during the hypnotic state shall be remembered. Ordinarily on waking the hypnotized person forgets all that has happened to him during hypnotization, but if he be rehypnotized it is stated by several authors that he recollects all the circumstances of the previous hypnotic state, so that he appears to live in two conditions, an ordinary and a hypnotic, quite distinct from each other.

Suggestions of any kind can only be effectually made by the hypnotizer, unless he suggest to the subject that he shall receive suggestions from some one else.

By suggesting to a hypnotized subject who has only one eye—let us say the right—open, that he can see certain things with the right eye, *e.g.* a red card, and then shutting the right and opening the left, and suggesting that with the left he can see nothing or something different from what he saw with the right eye—*e.g.* a blue card—when both eyes are opened he will see either a red card with the right and nothing with the left, or a red card with the right and a blue card with the left, according to the previous suggestion. These phenomena are called unilateral hallucinations.

(*b*) *Motor Phenomena.*—Deviations from the normal properties of muscle are very frequent, and a great increase in their reflex excitability is common in hypnotized persons. Often we find that the simple stroking of any part will induce spasm, first of all of its muscles, then of the neighbouring muscles, and so the spasm slowly spreads till quite a large number are implicated. Heidenhain stroked the ball of the left thumb of his brother who was hypnotized. Almost immediately there was spasm of the left thumb, and afterwards the parts were affected in the following order : left hand, forearm, arm, shoulder, right shoulder, arm, forearm, hand, left leg, thigh, right thigh, leg, muscles of mastication, muscles of neck, and then the patient was dehypnotized.

In certain degrees of hypnotization, if the body be placed in any position, spasm of the muscles is at once set up, and consequently the attitude is maintained (*flexibilitas cerea*). This is designated the cataleptic state. The patient is in precisely the same condition as he is in the disease called catalepsy. The attitudes cannot be supported by a hypnotized person for the extraordinarily long periods that have been stated to be possible, but still they appear to be maintained rather longer than would be possible under ordinary conditions. Occasionally the muscles can be relaxed by suggestion. The difference between the cataleptic positions of hypnotism and voluntary attitudes, is well seen in the way they terminate. Tracings show that if, for example, it be the arm that has been held out straight in the hypnotized person, when it begins to fall it does so gradually and smoothly, and the respirations are regular ; but the arm held voluntarily falls jerkily, and the respiration is irregular. It is stated that no fatigue is felt in artificial catalepsy. The closely allied cataleptoid state which, according to the Salpêtrière school, is characteristic of the lethargic variety of hypnotism, will be described under that heading.

(*c*) *Sensory Phenomena.*—In all except the slighter degrees of hypnotization there is diminished cutaneous sensibility, and the fully hypnotized person is quite insensible to pain, so that surgical operations can be performed without his feeling them. When the anæsthesia is not absolute it is greater at the periphery of the extremities than elsewhere. Sometimes the appreciation of heat and cold is blunted, but, as we have seen, ordinary tactile sensations are capable of inducing reflex acts. Should the loss of sensation not be complete, it can be made so by suggestion.

(*d*) *Vasomotor Phenomena.*—Ordinarily there are none, but by suggestion the most strange phenomena can be produced. Not only is it possible to cause a local erythema at any desired spot, but even actual vesication. For example, Mlle. E. was hypnotized in the presence of MM. Bernheim, Liébeault, and Beaunis. Eight postage stamps were placed on her left shoulder, and it was suggested to her that they would raise a blister. Elaborate precautions were taken to guard against deception. She was kept hypnotized for many hours, at the end of which the stamps were removed, and under them was found a large blister. Tuckey mentions a case in which a painful patch of erythema was made to appear by the suggestion during hypnotism that the subject was burnt. She was soon rehypnotized; it was suggested that the burn would disappear, and when she emerged from the hypnotic state both the pain and redness had passed away. A flow of tears, or of sweat, can also be induced by suggestion. The volume of any part in the cataleptic condition, has been shown by the plethysmograph to be diminished, but that of the other parts of the body is increased. These variations can only be due to vasomotor alterations. The retinal vessels do not vary.

Bernheim quotes instances in which by post-hypnotic suggestion it has been possible to produce epistaxis, and even bleeding from the surface of the arm, but he goes on to say that these phenomena are very rare, for he has never succeeded in causing them. An experiment performed by Delbœuf (*De l'Origine des Effets curatifs de l'Hypnotisme*, Paris 1887) may be mentioned here. He says that he produced with caustic a similar burn on each arm of a patient, whom he afterwards hypnotized. He then suggested that one should heal before the other. Both were treated with the same dressing, but the one which it was suggested would heal first was cured ten days before the other. This extraordinary result cannot be accepted until the experiment has been frequently repeated.

(*e*) *The Phenomena of the Pulse.*—Hypnotism produces such slight variations that they are unimportant.

(*f*) *Respiratory Phenomena.*—Tamburini, Heidenhain, and others have shown that the rapidity of the respirations is at first very much increased; Heidenhain has seen them accelerated fourfold.

(*g*) *Phenomena connected with Muscular Power.*—This as measured with a dynamometer is diminished.

(*h*) *Ocular Phenomena.*—The state of the pupil is variable. Some of the colour phenomena are very complicated; the commonest are connected with complementary colours, green objects in rare cases appearing red. Sometimes if the subject is shown a white card, which it is suggested is green, he will say that the next white card exhibited is red.

(*i*) *Auditory and Tactile Phenomena.*—By hypnotic suggestion auditory acuteness can be augmented, and the time of reaction both for auditory and tactile sensations increased. These facts are of importance as showing the absence of simulation.

(*k*) *Olfactory Phenomena.*—In deep hypnotism ammonia, and other powerful substances held directly under the nose, do not cause sneezing.

Hypnotization of Animals.

That it is possible to hypnotize animals has been known since 1646, when Father Athanasius Kircher recorded that if a fowl whose legs have been tied together is placed in front of a chalk line on the floor the creature soon passes into a cataleptic state. In 1839 Wilson, in England, hypnotized the animals at the Zoological Gardens. In 1872 Czermak hypnotized sparrows, pigeons and salamanders (*Arch. f. Physiologie*, Bd. vii. p. 107, 1873). Preyer (*Die Kataplexie*, Jena, 1878) showed that many animals could be hypnotized, especially by sensory stimulation of the skin; as an instance it may be mentioned that Heubel (*Pflüger's Arch.* vol. xiv.) easily hypnotized frogs, by lightly holding them with the thumb on the back and the four fingers on the belly. Beard (*Journal of Comparative Medicine and Surgery*, April, 1881) has confirmed all these experiments, and shown that any method, such as the use of a bright light, which will rivet the animal's attention, will hypnotize it. Möbius (*Schmidt's Jahrbücher*, Bd. 160, No. 1, 1881) has collected a good deal of information on this subject.

The Waking from the Hypnotic State.

We have already explained that subjects can be aroused by suggesting to them that they shall awake. Often the simple command, "Wake up!" suffices. Also it may be suggested that they shall wake at some future time. If the operator says, for example, "You shall wake in five minutes," the subject returns from the hypnotic to the customary condition when the time has elapsed.

Any strong sudden sensory stimulus is likewise efficacious. Common methods employed are blowing into the face, lifting up the eyelids, a sharp slap, pressure on the ovaries, or a loud noise. The stimulus need not be strong if it is contrary to that which was used to produce the hypnotic condition. This explains how it is that if stroking the arm upwards, or upward passes in front of the subject, have been employed to cause the hypnotic state, stroking the arm downwards, or downward passes, will terminate it.

On waking the face may be slightly flushed, and there is a dazed expression, with occasionally a dull heavy headache, but this may be prevented if, while the subject was in the hypnotic condition it was suggested to him that when he woke he would feel no inconvenience. If the *séance* has been protracted he may feel weary, as after a long natural sleep.

Unilateral Hypnotism or Hemihypnotism.

It is possible by stroking the skin of the temple on one side to induce artificial catalepsy of the opposite side of the body, together with aphasia if the left side of the head has been stroked. Many other curious varieties of catalepsy and also of unilateral sensory disturbances may be produced. In such unilateral hypnosis the psychical powers are unaffected, and if in a hypnotized person in whom a visual hallucination has been suggested, unilateral catalepsy is induced, and the eye on the same side shut, the hallucination will nevertheless remain. All these considerations render it probable that one cerebral hemisphere suffices for psychical functions, and this is corroborated by the fact that the whole of the front of one frontal lobe may be destroyed by a tumour without any ill effect upon mental operations.

Conditions favourable to the Induction of Hypnotism.

The surrounding conditions should be those favourable to sleep. The room ought to be darkened and quiet, unless a light or sound are used to hypnotize, and then there should only be the one light or sound.

The operator, if suggestion be the method employed, must be firm but persuasive, and speak only for the purpose of inducing hypnotism. His voice should be distinct and monotonous, and the word sleep should be frequently mentioned. There is no special power to hypnotize possessed by a few persons only. Probably, any one can do it with practice, if he can inspire sufficient respect for his authority.

The subject should be free from all distractions, and his mind turned from all thoughts except the one on which he is told to concentrate it. He should sit back easily in a chair, expecting to be hypnotized, and as far as possible should be persuaded to believe in the operator's power.

Those who are accustomed to obey are better subjects than those who usually act for themselves, and this is perhaps the reason why the lower classes yield more readily to the operator than the cultivated. Heidenhain considers that the susceptibility to hypnotization depends upon the degree of sensory irritability, and that consequently pale anæmic individuals are most readily influenced. It is Liébeault's opinion that people with strabismus, slight nystagmus, convulsive tic, hysterical or epileptic tendencies, anæmia, or with a very vivid imagination, are particularly easy to hypnotize. The Salpêtrière school maintain that only hysterical individuals can be hypnotized, but the Nancy school and many other observers disagree entirely with this statement. All persons find they succumb more readily the more often they have been hypnotized. Cases of mental disease are particularly intractable. There are probably racial differences, but of these we know nothing for certain; but Schrenck-Notzing is of opinion, that whilst all human beings are susceptible to it, the English, Germans, Dutch, and Swedes are not so prone to be influenced by hypnotism as are the French and Italians. Liébeault, operating upon 1,011 people, found that only twenty-seven, or about 2·6 per cent. could not be hypnotized. Bernheim puts the figure at 7·9 per cent., but all the statistics are untrustworthy, for most of those persons experimented upon came to the hospitals for the express purpose of being hypnotized. Probably the number of insusceptible people among the class from which the patients of the Nancy school are drawn is about 15 to 18 per cent. Naturally the Salpêtrière school consider that many more women than men are capable of being hypnotized, but the Nancy school state that the numbers are almost equal.

There are also the widest differences of opinion as to the most favourable age. Beaunis considers it extremely rare to find any child under fourteen who cannot be hypnotized, while other authors believe it to be exceptional to find children who can be influenced. The probable cause for these differences is that the Salpêtrière school deny the term hypnotism to many conditions for which the Nancy school would allow it to be used. All are agreed that old age is not a barrier to hypnotization.

The time of day and proximity to meals are of no importance.

Some have maintained that even when he is hypnotized by sensory stimulation the subject is really suggested to sleep, for he knows what is expected of him. This cannot be so, for in the first place animals can be hypnotized by the same means as man, secondly persons who do not know what is expected of them may be hypnotized, and thirdly lunatics can sometimes be made to pass into the hypnotic state even when they are awake. From this it follows that hypnotization without the consent of the subject is possible.

Precautions to be taken in Inducing the Hypnotic State.

The consent of the subject should be obtained previously, and a third person, preferably one of the patient's friends, ought always to be present during the whole of the *séance*. No suggestions should, as a general rule, be made unless the subject has agreed to them beforehand, and they must never be such as will lead to pain. The suggestion that no ill effects will follow the hypnotism ought not to be forgotten. As occasionally the pulse, and often the respiration are influenced, it will be well to proceed cautiously, if the subject suffer from cardiac or pulmonary disease, although no accidents, as a result of these, have been recorded.

The Two Schools.

The authorities on the subject of hypnotism have arranged themselves into two distinct schools. One, known as the *Nancy school*, having for its exponents, Liébeault, Bernheim, Beaunis, Richet and others, believes that the hypnotic state can be induced in healthy persons; the other, known as the

Salpêtrière or *Charcot school*, having for its advocates Charcot, Richer, Gilles de la Tourette, Binet, Féré and others, maintains that it can only be brought about in those who are hysterical, or are at least neurotic subjects, having a strong latent tendency to hysteria, and who will be made hysterical by hypnotism. The Nancy school urges against this, that men and women are equally easy to hypnotize, that children, who are not generally regarded as so hysterical as young adults, are more susceptible to hypnotism, and that animals can be hypnotized. The Salpêtrière school ignores the latter argument, and contends that their opponents include under the head of hypnotism many minor conditions not worthy of that name. As might be expected, both sides say that the opposite school has not taken sufficient pains to guard against simulation, and to inquire into the antecedents of the subjects. Although the Charcot school fortifies its contention by quotations from authors not practising at the Salpêtrière, it must be remembered that they claim their main support from experiences gained at that institution, where there are few healthy people, and very many of the inmates are hysterical. The matter cannot be finally settled till we have further knowledge, and a large number of impartial experiments. The following section treats of another important divergence of opinion.

Degrees of the Hypnotic Condition.

The two schools differ radically in their subdivisions of the hypnotic state.

The Salpêtrière school describes three. Charcot was the first to define them. They are (1) the cataleptic state, (2) the lethargic state, (3) the somnambulistic state.

(1) *The Cataleptic State.*—This is usually produced (*a*) as a primary condition, by a loud noise, a bright light suddenly thrown on the retina, or by long fixation of the eyes on any object; (*b*) as a condition secondary to the lethargic state,

when the eyes, which are then shut, are opened by lifting the lids, and a bright light falls on them, but other strong sensory impressions may also be employed.

The eyes remain open and fixed, but will follow a bright object; tears soon roll down the cheeks. The cataleptic condition in which the body remains in any attitude imparted to it, and the tracings showing the difference between cataleptic and voluntary attitudes have already been described (p. 304). Cataleptic positions can be induced by various senses, thus the playing of religious music gives a devotional aspect to the face; or the muscular sense may be made the afferent channel, for example if the subject's hand be brought to the mouth as in kissing, the whole features assume a pleasing expression. Definite attitudes can also be excited by words. The tendon reflexes are greatly diminished. The skin is insensible to the strongest pain.

(2) *The Lethargic State.*—This is induced by looking steadily at an object, and, after the patient has gazed for some time, the approach of the lethargic state may be accelerated by closing the lids and pressing gently upon them. It may be made to succeed the cataleptic state by simply closing the eyelids, or leading the subject into a perfectly dark place. It is not a sudden condition unless the patient has been often hypnotized; it usually comes on slowly in a period varying from a few minutes to an hour.

The pupils are contracted, the eyes closed, the globes turned upwards and inwards, and the eyelids quiver. The limbs are quite flaccid and fall down when raised, as they would do under deep chloroform narcosis. The tendon reflexes are greatly exaggerated, and there is present the phenomena known as neuro-muscular hyperexcitability; that is to say voluntary muscles contract upon the application of the slightest stimulus to them, or to their nerves, *e.g.* contraction of all the muscles supplied by the median nerve follows a slight tap over it. These contractions are very powerful, but can be immediately removed by stimulating, in the same way, the antagonistic muscles if the subject is still in the hypnotic condition. They may last for several days after its termination; in such a case it will be necessary to rehypnotize the patient, and overcome the muscular contraction by stimulating their antagonists. The muscles supplied by the facial nerve form an important exception, for their contraction lasts no longer than the actual application of the stimulus to the nerve. Neuromuscular hyperexcitability can sometimes be produced by striking the tendons of the muscles, but it does not, like the cataleptoid contraction of the somnambulistic state, follow simple stroking of the skin. The volume of the affected part is increased, but in the cataleptic state it is diminished. The phenomenon known as the paradoxical contraction is often present. Analgesia is complete, but suggestions usually fail.

By opening the eyes to a bright light the cataleptic state is induced, and if only one is opened the body becomes cataleptic on the corresponding side, and remains lethargic on the other.

Neuromuscular excitability may be met with in hysterical subjects who are not hypnotized, and its production upon pressure over the facial nerve is one of the symptoms of tetany.

(3) *The Somnambulistic State.*—This is produced (*a*) primarily, by a weak, constantly repeated, monotonous sensory excitation, and may come on very rapidly, gazing for a short time at a given object being with some persons quite enough to produce it; or (*b*) secondarily to either of the other states by pressure or rubbing on the vertex of the head.

The eyelids are either shut, or only half open, and they may tremble a little. The subject seems to be asleep, but the muscular relaxation is not so complete as in the lethargic state. There is no neuromuscular excitability, but by blowing upon, or stroking the skin, a condition of spasm, called pseudo-catalepsy, is induced. It appears first in the muscles stroked, but often spreads to many others (see description of Heidenhain's experiment, p. 303). The difference between it and the cataleptic condition of muscles, is that there is resistance to attempts on the part of the operator to alter the attitudes, and it differs from the contraction of neuro-muscular hyperexcitability inasmuch as it cannot be relaxed by striking the opponent muscles. The tendon reflexes are normal. There is complete analgesia of the skin and accessible mucous membranes, but there is hyperexcitability to tactile and certain other sensory impressions. Suggestions of all sorts are usually very easy. While the subject is in the somnambulistic condition his memory is very acute, but on waking he remembers nothing of what has happened, unless a clue be given to him. The opening of the eyes and exhibition of a strong light does not produce the cataleptic state, but pressure on their globes leads to the lethargic.

The Nancy school does not recognize any such sharp distinctions as these, and classifies the degrees of hypnotism merely according to the depth of the hypnotic sleep. Therefore the number of the subdivisions vary in different classifications; for example, Bernheim makes nine, Liébeault six, Fontan and Ségard three, namely slight, medium, and profound. The common feature of all the subdivisions is the capability of the subject to react to suggestions. Dumontpallier, Magin, and Bottey likewise do not accept the three states of the Salpêtrière school, but consider that the characteristics of each are often irregularly mixed with those of the other two, Pitres has also described many intermediate conditions, and Schrenck-Notzing has completely failed to obtain Charcot's three stages. The majority of the latest writers on the subject side with the Nancy school, unless they are in some way associated with the Salpêtrière. They also very justly urge that, as Charcot and his followers have for years cultivated, so to speak, these three forms of hypnotism, it is difficult to be certain that a new comer is not unconsciously suggested into the same condition; and further, that some of the described results are obtained from patients who have been experimented upon frequently for many years, and therefore it is impossible to be sure that suggestion and expectancy play no part in the result.

Explanation of the Phenomena.

Many attempts have been made to explain the phenomena of hypnotism, but most explanations are only a statement of the facts clothed in high-sounding phrases, and some others, such as that of Preyer that altered chemical changes go on in the nerve cells, have no evidence to support them.

Heidenhain has, however, put forward an hypothesis which is in accordance with physiological facts. He first of all reminds us that there are numerous cases in which the function of nerve cell is inhibited by stimulation of distant nerve terminations. For example, Lewisson has shown that if the skin over the jaw of a frog be compressed by putting an india-rubber band around it, all power of voluntary movement is inhibited, and Adamkiewicz has found that the application of a mustard poultice to any part of one arm diminishes, and it must be by reflex inhibition, the sensibility of the corresponding part of the other. Heidenhain supposes that in the same way during hypnotization the combined rhythmical stimulation in most persons, or in some even the sudden stimulation, of the special senses, can inhibit the activity of the ganglion cells of the cerebral cortex. I need hardly allude to the numerous instances in which the activity of many parts of the brain is, as far as we can see, put into abeyance by the concentrated activity of one part. Soldiers in battle do not feel wounds, and not long ago I saw a man who was very excited whilst trying a difficult dive from a rock into the sea, and consequently did not feel in the slightest that in so doing he cut his foot severely. Heidenhain also reminds us that the depression or abolition of the activity of higher centres causes an increased reflex excitability of lower centres, as is proved by destruction of the cerebral hemispheres, which leads to an increase of motor reflex excitability. This fact explains the ease with which in hypnotized persons, reflex spasm of the muscles can be induced, and the readiness with which subjects unconsciously perform all sorts of reflex acts however absurd, for the automatic manner in which they are carried out shows that even the most complicated acts performed as a result of suggestion are really reflex. To explain post-hypnotic suggestion, we have only to suppose that the inhibition of certain cortical cells remains after awakening from hypnotism. The depression of the functional activity does not extend lower than the corpora quadrigemina, for in hypnotized persons the pupils generally react to light, and the power of maintaining the equilibrium is never lost.

Rumpf has suggested that the changes in the brain are primarily vaso-motor, and Heidenhain at one time thought that the depressed activity of the cerebral cortex might be due to anæmia of it; but he has given up this view because during hypnotism the face is often flushed, the retinal arteries are not contracted, and a person can be hypnotized even while under the influence of nitrite of amyl.

Much discussion has taken place upon the relation of the hypnotic state to ordinary sleep. It is a wide subject which want of space forbids our discussing, but many analogies are obvious, especially if the phenomena of sleep-walking, or somnambulism as some authors call it, be borne in mind. For information upon this subject the reader may consult Liébeault's *Du Sommeil*.

Dangers of the Hypnotic State.

The Salpêtrière school, impressed as it is with the close relationship of hysteria to hypnotism, considers that hypnotism should be avoided in those who, although not suffering from hysteria, have strong hysterical antecedents. This school believes that hypnotism is extremely liable to produce actual hysteria.

The Nancy school of course denies this, and all those writers who belong to it state that it is excessively rare to find that hypnotism does any harm when carried to the slight extent necessary for treatment by suggestion.

There is the possibility that post-hypnotic suggestions may be utilized for the purpose of crime, and there have been several accusations of rape performed during the hypnotic state. This difficulty can be avoided if a third person is always present. The argument that it is possible to use hypnotism for unlawful purposes might be applied equally well to many drugs.

It is stated that a special passion for those who hypnotize them may be developed in women, but it is very doubtful if this is ever true.

Heidenhain says that he has twice seen hypnotization bring on convulsions, which however lead to no harm, and he has never noticed any other disagreeable consequences.

Occasionally some of the suggestions, even when not post-hypnotic, persist after the termination of the *séance*, and the patient feels a headache; both these results can be avoided by a suggestion that they will not occur, or by rehypnotizing the subject and suggesting that on waking he shall be free from them.

In certain exceptional cases, persons who are too often hypnotized may become so susceptible that they pass into the hypnotic condition almost spontaneously, but this may to a large extent be obviated by suggesting to them that, for the future, it will be a difficult matter to hypnotize them.

Names of Minor Degrees of Hypnotization.

The reader, in studying the subject of hypnotism, will come across the following terms, and it will save him trouble to know that they indicate slight degrees of hypnotization. They are charm, fascination, biological state, *condition prime*, *veille somnambulique*, *coma-vigil*, *somno-vigil*, and sub-hypnotic state.

The Use of the Magnet as an Agent for Transference.

The Salpêtrière school believe that if, during hypnotism, its phenomena, such as anæsthesia, paralysis, &c., exist on one side of the body only, they may be transferred by the application of a magnet, to a similar position on the opposite side; but the Nancy school strongly maintain that the magnet has nothing to do with the result, which is really due to suggestion, for the subject always knows what the operator expects will happen, and the experiments of this school are so carefully conducted that the balance of evidence is in their favour.

For further information consult :—

(1) Braid. *Neurypnology. London*, 1843.
(2) Braid. *Magic, Witchcraft, Animal Magnetism, Hypnotism, and Electro-biology. London*, 1852. *3rd Edit.*
(3) Liébeault. *Du Sommeil.* 1866.
(4) Heidenhain. *Hypnotism. Translated into English by L. C. Wooldridge, D.Sc. London*, 1888.
(5) Beaunis. *Le Somnambulisme provoqué. Paris*, 1886.
(6) Fontan et Ségard. *Éléments de Médecine suggestive. Paris*, 1887.
(7) D. Hack Tuke. *Sleep-walking and Hypnotism. London*, 1884.
(8) Binet and Féré. "*Animal Magnetism.*" *International Scientific Series*, vol. lx. *London*, 1888.
(9) Richer et Gilles de la Tourette. "*Hypnotisme.*" *Dict. Encyclop. des Sciences Médicales. Paris*, 1888.
(10) Bernheim. *De la Suggestion et de ses Applications à la Therapeutique. 2nd Edit. Paris*, 1888.
(11) Tuckey. *Psycho-Therapeutics. London*, 1889.
(12) Obersteiner. *Der Hypnotismus. Wien*, 1887.
(13) V. Schrenck-Notzing. *Ein Beitrag zur therapeutischen Verwerthung des Hypnotismus. Leipzig*, 1888.

Separate articles are mentioned in the text.

CHAPTER XX.

THE THERAPEUTIC APPLICATIONS OF HYPNOTISM.

THE therapeutical applications of hypnotism are most conveniently considered under three headings :—(1) The use of it for hysteria by the Salpêtrière school. (2) The induction by it of analgesia for surgical and obstetric operations. (3) The alleviation of various diseases by means of post-hypnotic suggestions. The two first are quickly disposed of, for they are of but slight importance compared with the third.

(1.) The Treatment of Hysteria by the Salpêtrière School.

MM. Richer and Gilles de la Tourette advise that to calm a woman in a hysterical fit, either the lethargic or the somnambulistic condition should be induced. The patient should remain hypnotized for some time, and it is well to induce the hypnotic condition early in the fit, for if it be far advanced it is difficult to produce hypnotism. This is the only therapeutical use to which hypnotism is put by the Salpêtrière school.

(2.) Surgical and Obstetric Operations.

It was just beginning to get known that hypnotism could be used to produce analgesia for operations, when chloroform was discovered, and this soon quite eclipsed the employment of hypnotism. Our modern anæsthetics bring about more certain and safe effects than could be obtained by the most careful hypnotism, for this may take days to develop analgesia, and many patients, especially as their mind is completely occupied by the prospect of an operation, are insusceptible to the hypnotic influence.

On 12th April, 1829, Cloquet successfully operated for a cancer of the breast in a woman in whom hypnotic analgesia had been induced. The operation was quite painless, and only lasted twelve minutes. In the beginning of the present century there were other isolated instances, such as that of Loysel, of the employment of hypnotism in surgery, but the surgeon who first used it extensively was Esdaile, for an account of whom the reader should consult the article about him, by Dr. A. T. Myers, in the *Dictionary of National Biography*. His first case was one in which after the induction of hypnotism, the patient did not feel the injection of a hydrocele with perchloride of mercury. This took place on April 11, 1845. Esdaile was so successful in operating painlessly in many major operations, such as amputation of the forearm, that at the end of the first year of trial of the method he had had 100 successful cases. This attracted the attention of the Government, who appointed a committee to report upon the subject. Their report was so favourable that Esdaile was given a special hospital in which to carry out the treatment. In 1852 he published an account of 300 painless operations, perhaps the most important of which was the removal of an elephantine tumour weighing 7½ stone.

Engledue mentions a case of painless amputation of the leg by Mr. Ward in 1842, the patient having been previously hypnotized, and states that up to 1848 there had been performed, upon those who were hypnotized, nearly 400 operations, and about the same time Dr. Elliotson (*Surgical Operations in the Mesmeric State*, London, 1843) published an account of some cases. Those wishing for fuller information should consult the numbers of the *Zooist*, published about this period.

In 1851 Broca and Follin hypnotized a woman before making an incision into an abscess near the arm, and Guerineau employed hypnotic anæsthesia for amputation of the thigh. In 1859 Thomas used hypnotism for the painless opening of abscesses, in the beginning of the seventh decade of the present century some French surgeons performed operations upon persons in the hypnotic state, and Liébeault also used it to extract teeth. Recently Fürth (*Wiener Med. Woch.*, July 21, 1888) has recorded how he cut out a painful scar while the patient was hypnotized, and Fort (*Bull. gén. de Thérep.* August 30, 1888) relates a painless operation conducted in the same way. While the patient was still hypnotized he successfully suggested that when she awoke she should not feel any pain in the wound.

Hypnotism has been little used in midwifery. Liébeault endeavoured without success to diminish by suggestion the pains of labour. Fontan and Ségard publish three cases. In one the woman was hypnotized several times before her confinement, which, it was always suggested to her during the hypnotism, would be painless. She felt but little pain during the first two stages, but during the third she suffered much. The second case was unsuccessful. In the third, the woman was hypnotized just when labour began; at first she felt no pain, but the third stage was very painful. Pritzel (*Wien. Med. Woch.*, Nov. 7, 1885) has recorded the case of a primipara, who felt nothing during the whole of her confinement, which took place while she was in the hypnotic state, but she was in the habit of being hypnotized. Richer and Gilles de la Tourette conclude that, on the whole, it is of but little use for midwifery, and that it is difficult to hypnotize those in whom labour has begun.

(3.) Treatment by Suggestion.

There can be no doubt that some of the cures obtained in olden times by means of charms, amulets, magnets, &c., were the result of suggestion. The patient was so firmly impressed by the one idea of his restoration to health that he recovered. The same explanation applies to many of the rapid cures that have happened at places like Lourdes, and to those obtained by the animal magnetizers, such as Mesmer, who were for the most part charlatans. We all know that any disease, as the patient feels it, depends partly upon the diseased organ causing the sensations, and partly upon the mind which receives them, which may be capable of appreciating and retaining only one strong impression at the same time; for example, going to a dentist, and the anticipation of having the tooth out so occupy the mind that the pain disappears; and if a house, in which a hysterically paralyzed girl lies motionless, catches fire, she may get up, and run out of it. Powerful suggestions can act even during natural sleep. Hack Tuke mentions the case of a girl suffering from constipation, who dreamed that she took rhubarb, a drug which she abhorred; she then awoke, and had at once to get up to relieve the diarrhœa subsequent to her dream. Metallotherapy is another instance of cures which take place through suggestion. The patient firmly believes that the discs of metal, which in Chapter XXI. we shall show are in themselves virtueless, will remove the symptoms, and consequently they disappear. This however is not the place to consider all the cures by suggestion, which have been attributed to animal magnetism, to a special property possessed only by some particular object as a tree, spring, or stone, or to an occult power which is the peculiar possession of the operator. Those who have recorded facts of this kind are frequently so inaccurate—often wilfully—that it is not worth while to examine them.

Braid was the first to write in a rational manner about hypnotism. In his book entitled *Neurypnology* (1843), he treats the subject in a scientific spirit, records some striking cases, and comes to the two following conclusions: (1) "That this power can be beneficially directed to the cure of a variety of diseases which were most intractable, or altogether incurable by ordinary treatment;" (2) "That this agency may be rendered available in moderating, or entirely preventing the pain incident to patients whilst undergoing surgical operations." Curiously, although he cured his patients by hypnotism, he failed to see that the result was due to suggestion; he never employed verbal suggestion, but all sorts of operations which really acted in the same way, for the patient undoubtedly had his attention specially directed to the diseased part, and fully expected to be cured. In Braid's time hypnotism did not take much hold.

To Liébeault (*Du Sommeil*, 1866) belongs the credit of first treating patients by suggesting to them, during the hypnotic condition, that they will be cured; but his book met the same fate as Braid's, and was not noticed till recently. Very little work was done at the subject till, in 1882, Bernheim employed hypnotism successfully, and from that time he has treated many patients by it. Among others, the chief of those who have demonstrated the therapeutic advantages of suggestion and hypnotism are Fontan and Ségard, Voisin, Richet, Van Eeden, Delbœuf, Retterghem, Wetterstrand, and Forel.

Retterghem tried to treat by hypnotic suggestion 178 patients, but only 162 could be properly hypnotized; of these 91 were cured, 46 improved, and 25 were not improved. Fontan and Ségard operated upon 93 patients; 44 were cured, 43 improved, and 6 were not improved. Bernheim treated 105 patients, of whom 82 were cured, 19 improved, and 4 were not improved. These three groups of figures give 360 patients who were hypnotized for therapeutical purposes; 217 or 60 per cent. were cured, 108 or 30 per cent. were improved, and in 35 or 10 per cent. there was no improvement.

The method employed is the following: The patient's consent is first obtained, and he is allowed to remain a little while in a room where others are being hypnotized, as by this means he gains confidence. He then sits comfortably in a chair before the operator, is told to compose himself, to wish to sleep, and to think of nothing. The physician then talks to him in a firm monotonous tone in the manner already described on p. 298, and, if the eyelids do not fall, closes them. The patient in a space of time varying from a few seconds to a few minutes, is sufficiently hypnotized to receive the therapeutic suggestions which the operator begins to make to him, and which always comprehend the dogmatic statement made distinctly, and often repeated with great assurance, that on dehypnotization, or waking as it is usually termed, he will no longer suffer, and that no ill effects will follow the hypnotization. The suggestion must always be made with regard to symptoms, and not with regard to their cause. For example the operator must say, " You will feel no pain, you will sleep," not "The inflammation of your nerves (if the case is one of neuritis) will disappear." It is often customary to direct the patient's attention forcibly to the affected part by stroking it, or by lightly touching it. The suggestion occupies from a few seconds to one or two minutes; the patient is then left to rest quietly for a minute or two, before he is dehypnotized either by commanding him to awake, or in the rare cases in which this is ineffectual, by blowing into his face. Many operators hypnotize by Braid's method of making the patient stare at some object, and some employ at the same time that of suggesting sleep.

If the *séance* has been a success the patient on awaking finds that the symptoms have left him, or are mitigated, that no ill effects have followed the hypnotization, and that he is at once quite able to follow his ordinary occupation. The duration of the cure is very variable, sometimes a single sitting affords permanent relief, but often it is only temporary, and hypnotization with suggestion has to be frequently repeated to attain a lasting cure. Even if the disease itself is quite incurable we may do much good, because by hypnotic suggestion pain can be relieved and sleep induced.

The easiest disorder to treat is pain, such as that of neuralgia, which is not due to an organic cause, next come the various functional paralyses, and then certain derangements of the alimentary tract as dyspepsia, vomiting, and constipation, provided they have no organic basis, as growth or ulceration. In short the most favourable field is among the neuroses.

Failure is most likely to occur with intelligent, intellectual persons not accustomed to put themselves under the will of others, but used to analyzing and criticizing, hence well-educated people are bad subjects.

Almost all the facts in this chapter are taken from foreign authors. Englishmen are probably of all races the least susceptible to hypnotism, and neuroses are not common among the English lower classes. Therefore it is unlikely that much good will result from the therapeutic use of hypnotism in this country.

The following are the chief groups of disease for which it has been employed :—

Organic Diseases of the Nervous System.—Bernheim records ten, and Fontan and Ségard six cases under this heading, but among all these sixteen cases there is only one autopsy. In many of them it is, I think, very doubtful whether they were organic, and even if they were, it does not follow that all the symptoms were due to an organic cause, for functional disorders may be superadded. Bernheim's case, in which there was an autopsy, was one of cerebral softening affecting the internal capsule, corpus striatum, and optic thalamus, and giving rise to hemianæsthesia and hemiplegia, with post-hemiplegic trembling and contracture. These two last symptoms and the hemianæsthesia are said to have been cured by hypnotic suggestion. Fontan and Ségard relate two cases of hemiplegia, which was in each diagnosed as being caused by cerebral hæmorrhage. The patients were rapidly cured by hypnotic suggestion. With such a little material before us, we need not stop further to consider this group.

Hysteria.—Fontan and Ségard give three cases, Bernheim eighteen, Schrenck-Notzing eight, Hösslin one, and Schultz one (*Neurol. Central.*, 15th Nov. 1887). Almost all were cured by suggestion. Many other examples might also be quoted. Some operators simply suggest the hypnotic condition, others induce it by Braid's method, and he himself used hypnotism for many nervous disorders, several of which were probably hysterical. The number of *séances* necessary is most variable; often one is sufficient, but sometimes they have to be repeated frequently, for a month or longer. Hysterical aphonia seems to have been particularly easy to cure; but one of Bernheim's cases was very intractable to the simple suggestion that when she awoke she would be able to speak, and he therefore re-hypnotized her once a day for a week. On each day he suggested that she would be able to speak on a day in the immediate future which he named, and when she was in the hypnotic state she was made to repeat this statement after him. When the day came which he had fixed she was hypnotized, and told that when she awoke she would be able to speak. By this means she was cured. In the intervals between these successive hypnotic states she had no recollection of the suggestions made during them. This cumulative suggestion is said to be useful in obstinate cases. Hysterical men, as well as women, appear to be capable of cure by hypnotism, but we have no facts to show the proportion of success to failure in either sex. A good example of cure in a man is recorded by Nonne (*Neurol. Central.*, 1888, No. 7).

Among those benefited there were patients with all varieties of hysteria, from aphonia, slight anæsthesia, or paresis, to severe hystero-epilepsy. Suggestion is probably always more powerful for good in functional disorders of sensory nerves than of motor, and we may therefore suspect that hysterical anæsthesia will ultimately be shown to be more capable of amelioration by this means than hysterical paralysis or convulsions. All writers agree that hysteria is not more likely to be benefited than other neuroses.

Painful Functional Neuroses.—Nearly all authors, who treat of the therapeutical uses of hypnotism, bring forward many instances of neurotic pains rapidly cured by it. The diseases included under this heading are—neuralgia, sciatica, migraine, and various pains in all parts of the body. These are the cases in which the cure is most rapid and certain. For example, Fontan and Ségard's thirty-second case is that of a woman suffering from migraine. She was hypnotized in a quarter of a minute by fixation of the eyes, and told that all the symptoms would disappear immediately; she was then awakened, felt nothing of them, and had no further attack during the three weeks she was under observation. Hypnotic suggestion effects cures even in the most severe cases, and in those in which other means have failed. It is also well worth a trial when the cause of the pain is, for the time at least, irremovable, and of organic origin. Liébeault, for instance, has recorded cases in which the pain of toothache was greatly soothed by the suggestion, made during the hypnotic state, that it would not be felt.

Functional Disorders of Movement.—As long ago as 1866, Liébeault stated that he regarded hypnotism as one of the best means of treatment for chorea, and in Beaunis' book there is given a woodcut showing the writing of a choreic patient before and after treatment by suggestion. The child was about twelve years old; she had had five severe attacks of chorea since she was four and a half years old. She was hypnotized five times in ten days, and during hypnotization it was suggested to her that the movements should cease. The efficacy of the treatment is graphically proved by the figures (Figs. 32 and 33).

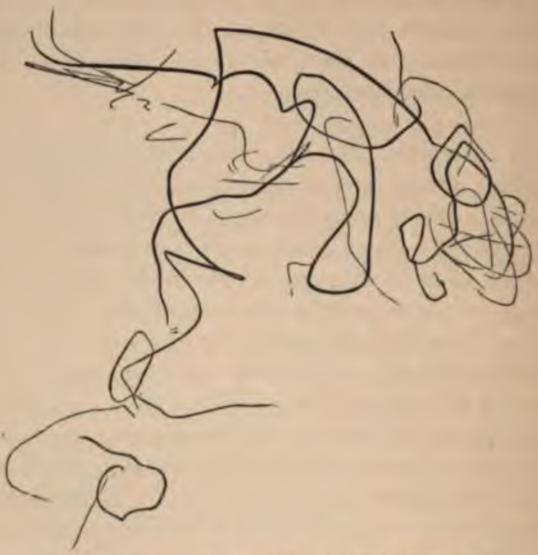
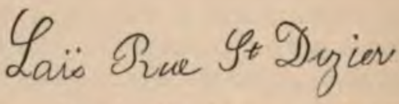


FIG. 32.—Shows the attempt to write before treatment.



Laïs Rue St Dizier

FIG. 33.—Shows the writing after treatment by hypnotism.

Bernheim has also treated many cases of chorea, several of which have been cured by a single sitting. Very little attention has been devoted to the treatment of epilepsy by hypnotism, but Liébeault suggests that it would be worth while to try to cure it by hypnotizing the patients between the attacks, and suggesting that they should not suffer from others. Bernheim records one case of writer's cramp which was completely relieved in two months by hypnotic suggestions frequently repeated.

In attempting to cure any form of paralysis by hypnotism it is well to make what is called an active suggestion; for example, if the legs are paralyzed, it is suggested to the patient, while he is in the hypnotic state, that he shall walk. If he does so, when he wakes he finds by his altered position that his walking powers are greater than he thought them to be, and this is a great encouragement.

Insomnia.—Hypnotic suggestion has been found to be useful for this condition. Fontan and Ségard give the case of a young man in whom the power to sleep was completely restored by it. He was hypnotized on three alternate days, and on each the suggestion was made that he would have a good night: it was always fulfilled, and after the third *séance* he was not troubled any more with sleeplessness during his stay in the hospital. Frey (*Wien. Med. Presse*, June 17, 1888) records three cases in which he found hypnotism useful for the insomnia following surgical operations; Bernheim also gives three, and Tuckey one, all of which were quickly cured.

Alcoholism, Opium, and Chloral Habits.—Several of these extremely difficult cases have been successfully treated by hypnotic suggestion. Perhaps one of the best is that which Tuckey quotes from Van Eeden. The patient was a confirmed drunkard, who had had delirium tremens many times. He was hypnotized once a day for a week, and once a week for two weeks. Whilst in the hypnotic condition, a disgust for stimulants was suggested, and he was made to solemnly promise to abstain from them; he was completely cured. Fontan and Ségard also give two striking cases of the cure of chronic alcoholism. Schrenck-Notzing quotes from Hösslin the case of a patient suffering from the morphia habit who was cured by hypnotic suggestion, and Voisin records a similar case in *La Revue de l'Hypnotisme.*

Mental Cases.—We have already seen that lunatics are difficult to hypnotize, and the balance of opinion at present is that the treatment of them by hypnotic suggestion is not of much avail, but some physicians have obtained very good results. The whole subject is very complicated, and it will probably be many years before any certain conclusions can be drawn. Voisin (*Annales Medico-Psychologiques*, 1884) mentions the case of a girl who suffered from hallucinations and fits. She was extremely depraved and immoral but when in the hypnotic condition she behaved like an honest and virtuous person. By being frequently hypnotized her state of mind, between the *séances*, was much improved. At a medical congress held at Blois, he related another case, that of a lunatic who thieved, swore, was obscene, very noisy and excited, but became calmer when hypnotized and was ultimately cured by hypnotic suggestion. In the *Revue de l'Hypnotisme* for 1886, he gives other cases in which he hypnotized lunatics, and suggested to them that they should no longer suffer from hallucinations; by this means he cured them, and one woman, who obstinately refused all food was persuaded to eat like ordinary people by suggestions made to her during the hypnotic state. The same journal for 1888 contains another case by Voisin of moral depravity: also one of acute puerperal mania, and one of severe hypochondriasis, both recorded by Burckhardt; all these three were cured by hypnotic suggestion.

Braid mentions some remarkable successes that he had with deaf mutes. His method was to hypnotize them, and to fan the ears. The hearing was always much more easily recoverable than the speech. Liébeault, on the other hand, tried most persistantly to cure some of these patients, but without much result.

Incontinence of Urine.—Bernheim, and Fontan and Ségard record five cases in which, by a single hypnotic suggestion, this malady was cured, although it had existed for years, and other physicians have had equally good results

Liébeault (*Abeille Méd.* t. xliii. p. 369, Paris, 1886) has treated seventy-seven cases including adults and children: twenty-three were completely and quickly cured, twenty-three were completely cured but not so quickly, ten appeared cured but relapsed, nine were improved, eight were not improved and four could not be hypnotized.

Anæmia.—Liébeault, and many other physicians of the Nancy school, speak very highly of suggestion as a remedy for that form of anæmia which is met with in chlorotic women. In *Du Sommeil* will be found an account of thirty-nine women, of whom sixteen were completely cured, one was not improved and the remainder were somewhat benefited. The mildest cases were treated by simple suggestion without hypnotism, the others by suggestions made during one of the stages of the hypnotic condition. Not only did the anæmia improve, but also its accompanying symptoms such as hæmic murmurs, palpitation, vomiting, &c. The suggestion made was that the patient would not feel any of the symptoms from which she suffered, each of them being named slowly and distinctly, while the attention was directed to the part in which each was manifested.

Rheumatism.—Bernheim has employed hypnotic suggestion in a large number of cases to remove the pain of rheumatic myalgia, and that felt in the joints in slight degrees of rheumatic arthritis. He gives eighteen cases, and in all of them the pain was much relieved, and in most it disappeared entirely. Fontan and Ségard also describe eight cases. Braid says of the treatment of rheumatism, especially the chronic variety, by hypnotism, "I have, on the whole, seen far more successes, more rapid and decided relief, follow this mode of treatment than any other. In its application I first induce the somnolent state, and then call into action the different muscles which I consider directly affected. The patient must be retained in such a position a longer or shorter time according to circumstances." Probably the best way of treating these cases would be to combine with the suggestion that the pain and immobility would disappear, extension of the muscles, as practised by Braid. Chronic rheumatism is a disease so liable to recur, that we cannot at present form any opinion as to the permanence of the results of treatment by hypnotism. The deformity of the joints is probably uninfluenced.

A few cases of benefit in what is styled "acute rheumatism" have been recorded, but whether they were always examples of rheumatic fever is doubtful; but still in this, as in any other fever, it may be quite possible to diminish the pain and insomnia by hypnotic suggestion.

The cases of what is called lumbago that have been cured by hypnotic suggestion were probably examples of muscular rheumatism.

Amenorrhœa.—Several of the Nancy school have treated this complaint by suggestion. Voisin (*Annales Médico-Psychologiques*, March 1887) records some cases in which he successfully suggested, during the hypnotic condition, that the menses should appear painlessly at a given time. By this means he claims to have cured sufferers from amenorrhœa. In those women in whom the menstrual flow is too frequent, or too abundant, it is said that it may be checked by suggestion.

Dyspepsia.—This is, in Nancy, very frequently treated by hypnotic suggestion. The neurotic variety yields most readily. Other varieties can also be relieved; for example, Tuckey quotes a case of Van Eedens, in which a delicate child who suffered from severe gastric pain and dyspepsia was completely relieved by one or two hypnotic suggestions. Certain forms of nervous vomiting and diarrhœa are also much benefited.

Post-hypnotic suggestion has been employed therapeutically in many other conditions, but not sufficiently often for the results to be recorded here. Usually its object has been either to relieve pain, to remove some neurosis, or to produce sleep.

It has been proposed that it may some day be used as an educational means for children who are particularly wayward and incorrigible.

The whole subject of the therapeutical use of hypnotism is in its infancy. We must receive all reports of cases said to have been cured by it with the greatest caution, and probably future experience will show that many authors have exaggerated its value.

CHAPTER XXI.

METALLO-THERAPY.

It has often been thought that metals applied to the skin have some powerful influence. Dr. Elliotson maintained that if nickel was drawn along the palm, the person became hypnotized, but that lead had no such effect. An animated discussion sprang up between him and Mr. Wakley, who ultimately proved that if the patient believed the lead to be nickel, the same results followed. This demonstrated that it was, as Braid concluded, nothing but the suggestion of sleep that hypnotized the subject, and that metals have no special hypnotizing properties.

Interest in the subject flagged, although Burq in 1851 published a thesis, in which he claimed that he could cure hysterical anæsthesia by the application of metals to the insensitive skin. In 1877 the Société de Biologie of Paris appointed a committee composed of MM. Charcot, Luys, and Dumontpallier, to report upon the subject; and in 1879 their report was published in two portions under the title of *Étude expérimentale sur la Métalloscopie et la Métallothérapie*. It, together with much other information on the subject, will be found summarized in Wood's *Therapeutics, its Principles and Practice*, 7th edit.

The committee came to the conclusion that if a disc of metal be bound down with a bandage or handkerchief on a part affected with hysterical anæsthesia, there appears under the metallic disc a patch of erythema, then sensation returns and usually spreads slowly far beyond the point of application of the disc. The erythema gradually disappears, but the sensation remains for a varying time which is never more than a few hours. An anæsthetic limb is usually slightly colder than a healthy limb; after the application of metals the natural warmth returns, and also any paresis that might be present is partially alleviated. Sometimes coincident with the renewal of sensation, a patch of anæsthesia appears on the corresponding part of the other side of the body. By applying the discs to the skin near the eyes, various hysterical defects of vision, such as achromatropsia, can be remedied. Some persons react best with gold, some with silver, some with copper, some with zinc, and some with other metals. The time during which the metals should be applied varies much with different people.

Towards the end of the first part of the report, Charcot says that he has been able to relieve organic hemianæsthesia by metallo-therapy.

In the second part, the statement of Burq that good results may be obtained by the internal administration of the same metal, which when applied externally diminishes hemianæsthesia, is confirmed; but the cures were probably not permanent, and strange to say, if by this internal administration the anæsthesia had been made to disappear, it could be brought back by the application of the same metal to the skin. Lastly by the local employment of metals upon a patch of hysterical hyperæsthesia it could be reduced to normal sensibility.

Many French observers have confirmed these statements, and some have even resuscitated the old claim that magnets can act powerfully in diminishing anæsthesia. Dr. Hughes Bennett (*Brain*, vol. i.) has obtained some good results, and in the *London Medical Record*, vol. ix., others will be found recorded. The few experiments that I have seen made were not very successful, and Wood states that in America careful trials by Weir Mitchell and C. K. Mills, have almost completely failed to obtain the phenomena.

Many explanations have been suggested. It was noticed that the application of metals to the skin developed weak currents of electricity, but that these have any curative effect upon anæsthesia is rendered improbable by the fact that often equally good results may be obtained by the use of discs of wood, potato, &c., and also by blisters, collodion, faradic electricity, or some vibrating instrument. (Féré, *La Médicine d'Imagination*, *Prog. Med.* 1884–86.) These facts, together with Wakley's experiment, prove that the alterations brought about do not depend upon the virtues of any particular metal. It is almost certain that they are due to the suggestion, either directly or indirectly made to the patient, that a variation in the symptoms is expected, or to the inhibition of certain parts of the brain by peripheral sensory stimulation, a mode of action already discussed in the chapter on hypnotism.

This suggestive explanation applies equally well to the cure by the internal administration of the metal.

No attention need be paid to the rubbish that has been written about the molecular action of metals placed upon skin.

CHAPTER XXII.

TREATMENT OF DISEASES OF THE SPINAL CORD BY SUSPENSION.

Motchoukowski of Odessa published a pamphlet on this subject in 1883 (*Vratsch.* No. 17–21, 1883). He was first led to adopt the treatment because there came under his care a patient who had both tabes dorsalis and spinal curvature. For the curvature he was frequently suspended, in order to apply plaster of Paris jackets. Motchoukowski was so struck with the improvement in the tabetic symptoms that this patient appeared to derive from being frequently suspended for a few minutes at a time, that he treated twelve persons suffering from tabes dorsalis by suspension without applying the jacket. These were also benefited. His paper passed unnoticed till Raymond, who was travelling in Russia, brought to Charcot an account of Motchoukowski's method, and it was then at once adopted at the Salpêtrière.

The apparatus employed consists of a headpiece passing under the chin, and two loops for the armpits, all connected by a cross-bar, which is attached to a pulley dependent from a hook in the ceiling. It is, in fact, exactly similar to an ordinary Sayre's apparatus, but it is advisable not to use a tripod, lest, as many of the patients are ataxic, they should kick it over. A description of it is given by Gilles de la Tourette (*Le Progrès Médical,* February 23, 1889), and by

De Watteville (*Brit. Med. Journal*, March 9, 1889, p. 555), who has also translated into English Professor Charcot's article on *The Treatment of Locomotor Ataxy by Suspension*, and published it in London (D. Stott, London, 1889).

During the suspension the patient should not be allowed to swing about. It is generally said that the time for which actual suspension lasts should never exceed three or four minutes, although Morton allows five or seven minutes, and Motchoukowski occasionally as long as ten minutes. At first it ought to last only half a minute, and the extreme limit may be reached after equal increments, by the sixth or eighth suspension. If the patient is very heavy, he must not be kept hanging for more than two or three minutes, and he should never remain suspended sufficiently long to produce fatigue, nor should the treatment ever be adopted if it cause pain. If he can, he may occasionally lift up his arms slowly so as to bring the force of his own weight more directly on the vertebral column. It is well to take off his coat, but no further undressing is necessary. He ought to be gently lowered after the suspension, either into an arm-chair placed near for the purpose, or into the assistant's arms, and then put to rest for a few minutes on a couch. The suspension should take place on alternate days.

The treatment has been applied in the following diseases:—

Tabes Dorsalis.—Charcot (*Le Progrès Médical*, January 19, 1889) reports that during three months he has treated fourteen patients suffering from tabes dorsalis, and altogether these fourteen patients have been suspended about 400 times. He states that after a few suspensions the in-coordination becomes less. At first the amelioration lasts for two or three hours only after the operation, but this time gradually extends till, in three weeks or so, the improvement endures from one suspension until the next. The patients soon become able to walk without help. After about twenty or thirty suspensions the power of standing with the eyes shut is much greater, and vesical troubles, such as incontinence, improve. The patient feels also less of the lightning pains, and if there has been impotence, sexual desire and the possibility of erections return, the numbness and patches of anæsthesia disappear, the general health is benefited, and he regains any power of sleep he has lost. Among Charcot's fourteen patients, the degree of improvement seems to have been determined by the length of the treatment in all but two; in these the slight benefit was stationary. In the *British Medical Journal*, March 2, 1889, Dr. Saundby gives an account of three patients with tabes dorsalis, for whom he used suspension. They had not been sufficiently long under treatment when their cases were reported for any estimate to be formed as to the value of the method, but so far there was but little benefit. They all, in addition, took 30 grains of iodide of potassium three times a day, and two were blistered down the spine.

Profs. Eulenberg and Mendel have treated twenty patients in Berlin, with at least some temporary relief, especially with regard to the power of walking and the lightning pains. Dr. Morton (*New York Medical Record*, April 13, 1889) gives an account of the treatment of six cases. He finds that many of the symptoms, such as in-coordination, the Argyll-Robertson pupil, pains, and irregular micturition, were relieved quickly, and he considers that it is by far the best treatment for tabes dorsalis that we possess. He prefers that, if possible, the patients should suspend themselves, and that the toes should just touch the ground. He uses an apparatus in which the patient can with his own arms pull down a cord from a pulley connected with the headpiece. In the same journal of the same date, Dana also reports favourably of the method in this disease. Notes of results obtained by many physicians will be found abstracted in *Le Progrès Médical*, 27 April, 1889, p. 320. The treatment has been tried at Guy's Hospital, but it would be premature at present to say whether it has been successful.

We have not before us nearly enough material to pronounce upon the value of this system. More cases must be collected, the treatment must be applied longer, and we must wait to see if the improvement is permanent.

Friedreich's Disease.—Paul Blocq (*Revue Générale de Clinique*, Feb. 14, 1889) has treated by suspension a girl, aged fourteen, suffering from this disease. She was suspended for the usual time about every other day for thirty suspensions. Her mother thought the improvement extraordinary. She walked much better, could carry a spoon to her mouth with the eyes closed, and in all movements her co-ordination was improved, and her general health benefited, but the tendon reflexes remained absent, and there was no amelioration either in the speech, or nystagmus. A patient whom Dana (*op. cit.*) treated said that suspension made him feel better than he had been for a long while.

Impotence.—Onanoff and Motchoukowski think that perhaps experience may show this treatment to be beneficial for the neurasthenic individuals who suffer from impotence. Charcot tried it in two cases with good results, and considers the method worthy of further attention.

Disseminated Sclerosis.—It was tried at the Salpêtrière on one patient, and by Motchoukowski on another, both of whom suffered from this disease without, however, any benefit.

Paralysis Agitans.—Dana (*op. cit.*) used the method for two patients suffering from this disease. One felt much better after two suspensions, and was so taken with the treatment that he used to hang himself from the top of the door at his home several times daily. The other patient was not much benefited.

Myelitis.—Motchoukowski tried suspension for diffuse myelitis, but no good resulted. One of Dana's most successful cases was, however, a patient with transverse myelitis, who seemed much improved after thirteen suspensions.

Lateral Sclerosis.—A few patients with lateral sclerosis have been suspended, but they have not been benefited thereby.

We do not know how the suspension acts, it has been suggested that the thickened meninges and nerve-roots are stretched, that the cord is straightened, and that the circulation in it is modified. It is said that the suspension is most suitable for very chronic cases, and is liable to do harm in those in which there is probably some recent inflammation about the meninges and nerve-roots. If this be true, it is some evidence in favour of the view that the suspension acts mechanically on the meninges, nerve-roots, and spinal cord. Motchoukowski found that the suspension of a corpse lengthened the distance between the second cervical and fourth lumbar vertebræ by 2¼ cm. In discussing the mode of action of this method it must be remembered that Abadie, speaking at the Medical Society of Paris, on February 23, 1889, said that in his experience it succeeded best in cases that were not typical examples of tabes dorsalis.

The suspension should always be carried out by a doctor. In the *British Medical Journal*, June 1, 1889, two cases are quoted in which the patients suspended themselves. One dislocated his neck and thereby killed himself, and the other probably had the same accident, for he was found dead.

CHAPTER XXIII.

GENERAL TREATMENT OF ACUTE DISEASES, CONVALESCENCE AND INSOMNIA.

THERE are several items of treatment which could not be suitably grouped under the headings of any of the previous chapters, and therefore we will consider them here. They are applied chiefly to diseases which oblige the patient to stay in bed. Although most maladies require for their successful treatment scrupulous attention to a number of minute details, especial care is necessary in these cases.

The room in which the patient is about to lie up should, if he is to be its sole occupant, have a cubical content of 3,000 cubic feet, which can be obtained by choosing one twelve feet high and sixteen feet in both width and breadth. In a ward where there are several patients 1,500 cubic feet for each is sufficient, unless the disease be infectious through the air, when 2,000 cubic feet should be allowed.

Free ventilation is essential. In nearly all rooms this is best attained by a fire in an open fireplace, and unless the weather be very cold or the noise in the street very great the windows may always be open a little. It is a good plan to keep the lower sash raised by a long piece of wood under it, so that there is a permanent opening between the two sashes through which an upward current can come from the outside. The room should not be ventilated with air that has passed through the rest of the house. In bygone days very little fresh air was allowed, windows were pasted up, and sick rooms became horribly stuffy. The doctor must set his face against this. The atmosphere of the sick room should always be fresh and sweet. The bed must be so placed that it is out of all draughts.

The temperature of the room should be about 50° F. The mistake of making it a kind of oven is frequently committed. A temperature of over 50° is only required in cases of lung disease, such as bronchitis, in which cool air may irritate the respiratory passages. It is then advisable to raise the temperature to 60° or 65° F., and to keep the air moist by means of a steam kettle on the fire. With the majority of fevers no harm is done if the temperature falls a little below 50° F. Often the patient is encumbered by too many bedclothes. If his temperature is raised it is an advantage to keep him cool, provided that he is not chilled. In summer a sheet and one thin blanket is all that is required.

Natural light ought to be as abundant as possible, and therefore a room with windows facing south is to be preferred. It is impossible for them to be too large, but they must have blinds that will darken the room during the day if the patient desires to sleep. The bed should be placed with its side to the light, so that by turning over he can direct his eyes away from it. Any artificial light ought to have a shade in order to get rid of the glare, and should be capable of being arranged in such a manner that the greater part of the room may be in darkness.

Noise is most harassing to the invalid, and is therefore injurious, to say nothing of the impossibility of sleeping through it.

Cleanliness should be most thorough. If there is time before the reception of the patient, all old paper should be stripped off the walls. These should then be distempered with some quiet dull colour. Shades of blue are more sedative than reds. The advantage of distemper is, that after the illness the wall can be quickly and cheaply redistempered. If it is papered, the paper should be varnished, as it can then be easily washed, and such a design should be chosen that the patient cannot, by frequently looking at it, irritate himself by discovering patterns. The ceiling ought to be whitewashed, and the floor scrubbed. The best flooring for a sick-room is composed of boards close together, for then no dust can come up between them. The only floor covering should be a strip of carpet or new cocoa-nut matting on either side of the bed. Curtains, bed-hangings, and valences should be banished, as they collect the dust. There ought to be as little furniture as possible. All urine, evacuations, and sputum must be promptly removed, and no specimens that have to be saved for the doctor should be kept in the room. Neither should any washing-up or cooking go on in it, and the nurse ought not to take her meals in it, and if it be necessary that she should be within call when asleep, her bed should be in some room opening directly out of that of the patient.

The Bed.—Unless the case be a surgical one, requiring some particular kind of bed, the most suitable is a horsehair mattress on a spring bed. The bed clothes ought to be light. If the patient perspire much, a flannel nightdress should be worn, and changed as often as necessary, otherwise a soft cotton or linen garment which fits loosely is the best.

The bedstead should be of iron, so that it can be easily cleaned, and ought not to be so wide that the patient cannot be readily reached. It will be found much easier to shift him to make the bed if there is no footpiece and only a low headpiece. A stretcher on to which he can be moved while his bed is made is a great help, for it saves the exhaustion of sitting up and allows the bed to be thoroughly aired. A pulley with which he can lift himself greatly facilitates the passage of the drawer sheet and bed-pan. A bed-rest is almost necessary when he begins to sit up, and a bed-table makes his meals much more comfortable.

Infectious Diseases.—All that has just been said applies with great force to these, and in addition careful attention must be paid to the following points :—

Every article used in the patient's room must be kept apart from those belonging to the rest of the household, and should be washed frequently in carbolized boiling water in the sick chamber, or in an adjacent room set specially apart for the purpose. All rags and dressings ought to be burnt directly they are no longer required. The nurse should change her clothes and wash before leaving the rooms devoted to her and the patient. She should sleep and take her meals in one used only by her. Very few visitors can be allowed, and all who see the patient should wash thoroughly, and if possible change their outer clothes on leaving him. For the disinfection of all linen, &c., Calvert's carbolic acid No. 5, in the proportion of half a fluid ounce to the pint of water, may be employed, and the same strength can be used for wetting the sheet that is hung over the outside of the door. Whenever practicable, boiling is the best disinfectant.

After the illness, when the patient has left his room, all parts of it and its furniture should be washed with hot carbolized water, and the paper stripped off the walls unless it also can be washed. The chimney should then be stopped up, all the crevices of the windows pasted over, the drawers and cupboards thrown open, and a quarter to half a pound of flowers of sulphur placed in a metal or earthenware vessel. The sulphur is to be lit, the door shut, and the cracks around it pasted over. The room should be left untouched for six hours. The windows are to be thrown wide open at the expiration of that time. All fabrics which will not thereby be spoiled should be boiled. Those that cannot be boiled, should, together with the bedding, be sent to the sanitary authorities, who will heat them in an oven. This is the most certain mode of disinfection. Moist hot air is a more powerful destroyer of germs than dry. There is some doubt as to the exact temperature necessary to kill them, but it must be considerably above boiling point.

Smallpox.—Directly a case is discovered, all persons who can possibly have come in contact with the patient should be vaccinated, although they may show marks of previous vaccinations. If this is done within forty-eight hours of the time when they were first exposed to the infection they will escape. If vaccinated within three days their attack will, if they catch the disease, be modified. After the third day vaccination is useless. The patient should not be allowed to mix with other people till the scabbing is quite completed.

Scarlet Fever.—This is contagious till desquamation is completed, which is usually six or eight weeks from the first onset of the malady ; the patient must therefore be rigorously isolated for the whole of this time, and he must be thoroughly examined for peeling before he is allowed to mix with other people. It has been said that the risk of infection is much diminished if the skin is kept well greased. The following ointment has been recommended. I have used it, and it has seemed to me satisfactory :—Solid carbolic acid thirty grains, thymol ten grains, vaseline a drachm, simple ointment an ounce. It should be rubbed in every night and morning after a warm bath, for the whole of the six or eight weeks.

Measles is most contagious during the first few days. The patient should remain isolated for four weeks from the commencement of the illness.

Typhoid Fever.—In this disease isolation is not necessary, but the greatest possible care must be taken to see that the stools are properly treated. A powerful disinfectant should be put into the bed-pan before use and also directly after. They must be quickly removed from the room and poured down the closet, into which some disinfectant should immediately be thrown. Any soiled linen ought at once to be boiled, and all splashing of the contents of the bed-pan must be prevented. Those who have to look after the patient should frequently wash their hands, for if they do not they may accidentally infect articles of food which transmit the disease.

Diphtheria.—Special care must be taken to avoid receiving into the mouth or on the face any of the material expectorated.

Diphtheria, typhoid fever, and scarlatina may all of them be transmitted by food, especially milk.

After an acute febrile disease the patient should not be allowed to get out of bed till his temperature has remained normal for a few days. The exact number will depend upon the degree of prostration. At first half an hour or an hour in an easy-chair is all that he can endure.

In *typhoid fever* he should remain in bed for at least a fortnight after his temperature has fallen, and the diarrhœa has stopped. This is necessary on account of the likelihood of perforation.

After *rheumatic fever* he must not get up till at least ten days after the pain has disappeared, and the temperature has fallen. If this rule is disobeyed a relapse is probable. For information as to the diet in the various fevers reference should be made to Chapter VII.

Convalescence.—This is slowest from typhoid fever, rheumatic fever, diphtheria, and pyæmia. The diet for convalescence has already been discussed (p. 102). One or two other points remain to be considered.

Clothing.—Discretion must be exercised, for convalescents are sensitive to alterations in temperature, and easily catch cold, but the guiding principles are the same as for healthy persons.

Of all materials wool is the warmest, fur is slightly inferior to it, and silk slightly inferior to fur. Cotton is not nearly so warm, and linen (flax) is the coolest of all. The colour makes very little difference to the quantity of heat leaving the body; but black absorbs twice as much of the sun's heat as white, consequently we wear dark clothes in winter, and light clothes in summer. Yellow and light green are in this respect near to white; blue and dark green are near to black, and red is intermediate. Wool has not only the advantage of being very warm, but as it is hygroscopic, it quickly removes the moisture from the surface of the body, and conveys it to the outside of the clothes where it evaporates. Hence wool should always be worn next to the skin all the year round, thinner garments being used in summer than in winter. If it irritate, silk may be substituted, but under no circumstances should linen or cotton be next to the skin, for not only is there but little warmth in them, but they are not hygroscopic, and the sweat is not conveyed away. As it slowly cools it forms a layer of cool fluid lying next to the body, and colds are frequently the result. When any severe exercise is being taken wool must always be worn. Cheap merino and what is sold as spun silk are nearly all cotton. Outer garments, such as macintoshes, which prevent evaporation, should never be worn long together. Loosely woven and loosely fitting clothes are much warmer than those which are tight, for the air between the folds is a bad conductor of heat, and it is because of the air among the hairs that fur is so warm. For the same reason two shirts are warmer than one double the thickness of either of them. The woollen undergarments should extend over the whole body and extremities; often the arms and legs are not covered, and, by a foolish freak of fashion, it is children who suffer most in this respect. The arms of their clothes ought to reach to the wrist, and unless they are in long clothes, they should always wear flannel drawers and woollen socks. It is no uncommon thing to see a child so badly clad that its clothes ride up to its waist, leaving the whole of the lower part of the body exposed. Want of warmth is a frequent source of infantile diarrhœa; children who are troubled with it should always wear a flannel binder round the abdomen, and many adult dyspeptics find themselves benefited by using one. A very useful article of dress for children is a knitted combination garment with long arms and legs.

Certain skin diseases may be traced to the use of underclothing, the surface of which is too rough, or to pernicious dyes, most of which owe their irritating properties to the arsenic they contain.

At night the sleeper should depend for warmth upon light, warm bed-clothes, and not upon his sleeping garments, which should be loose, so that air may circulate freely around the skin. They are best made of smooth cotton or linen, for they are not required for warmth, and it is desirable to rest the skin from the iritation of the wool.

Exercise.—The convalescent will, when he gets up, remain out of bed for only an hour or half an hour the first day, and this time can be gradually increased as he gains strength. It is much less exhausting to be out of bed for an hour in the morning and one in the evening than for two at a time. As soon as his strength and the weather will permit, he must go out of doors; if it is warm summer weather he may lie in the open air during the whole of the middle of the day, but must come in a couple of hours before sunset. A carriage drive is also to be recommended, but it should not be too long, for the mere movement is fatiguing. Soon he will begin to walk, little by little, and when he is strong enough to bear the journey he ought to get away from the place where he has been ill, for whatever be the illness from which he has suffered mere change of air and scene is beneficial. The journey must be made slowly, and by short stages; frequently the mistake is made of going too far at once, and the patient becomes utterly exhausted. The principles which should guide us in the choice of a place have already been laid down in the chapters on climatology. People on arriving at some holiday resort commonly commit the error of at once performing some severe muscular exercise; they ought for the first few days to rest, and the feats they undertake should at first be moderate.

The various forms of exercise suitable for different diseases have already been discussed (pp. 64, 97, 115). Here we need only remark that rowing is the perfection of exercise, as it brings into play all the muscles of the body. Riding also is excellent. The value of gymnastics is overrated, for most of the exercises throw nearly all the work on the arms, and the gymnasium is usually under cover. Brisk walking is good, but if the patient go alone there is no mental recreation, and for this reason some form of exercise such as a game which requires that the attention should be fixed on the object in hand, is far better. All excesses are bad, especially those which are severe for a short time.

Insomnia.—This is a condition so frequently treated by drugs when it should be combated without them, that it seems desirable to say a few words about it.

Drugs are only permissible if some cause which it is hoped will quickly pass away is the origin of the insomnia. Thus bromide of potassium may be given when the sleeplessness is due to migraine. It is allowable to give morphia to induce sleep during the pain experienced after operations, childbirth, or during an attack of colic; and it may even be right to give this drug habitually if the patient be suffering much pain and distress from some incurable disease that must eventually kill him. But with these exceptions drugs are not to be used for insomnia; if they are, gradually larger and larger doses will be required, they will lose their efficacy, the patient will become a slave to them, and consequently suffer, not only from sleeplessness, but from the evil effects of the drug.

The attempt must be made to remove the cause of the insomnia; for example, if it be dyspepsia this must be treated by drugs if necessary, and by the various means already described; if it be mental worry or business distractions a complete change of air and scene, especially a sea voyage, is advisable; if it be sheer exhaustion, as is often the case nowadays, a week's rest in bed will do good.

Many persons find they cannot sleep if the stomach be quite empty. Heavy late suppers should of course be forbidden, but a biscuit or two with perhaps a weak glass of spirits and water just before going to bed will render sleep more easy, and there should be a piece of bread and butter or a biscuit at the bedside for the sleeper to eat if he wakes in the night; by doing this he will often send himself off to sleep again, especially if at the same time he drink a glass of wine. Frequently tea and coffee even if taken several hours before bedtime will prevent sleep.

Cold feet are a very common cause of insomnia. Those who suffer from them should get thoroughly warm before going to bed. One of the best remedies is a hot bath and a warmed bed immediately after it. A hot water bottle and sleeping socks may be used to keep the feet warm. Probably both food and warmth act by diverting blood from the head. The value of the hot pack has already been mentioned (p. 147).

A nap in the evening often prevents sleep at bed-time.

The sleeping apartment should be perfectly quiet, double windows may be necessary, and cotton wool in the ears is also useful. The room should be dark, and have either shutters or blinds which will keep out the morning light.

Most persons find they can sleep best on their right side. This is because lying on the left side throws the weight of the liver towards the heart.

Regular and early hours must be kept. The whole body should be maintained in the best health possible. Outdoor exercise is very important. The mind should be as quiet and the entire life as placid and easy as circumstances will allow.

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